

ON THE *CHÆTOSOMATIDÆ*, WITH DESCRIPTIONS OF NEW SPECIES, AND A NEW GENUS FROM THE COAST OF NEW SOUTH WALES.

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(Plates xlv.-l., and 59 Text-figures.)

INTRODUCTION.

The *Chætosomatidæ* are a group of curious, little, free-living, marine worms, which appear to be related to the Nemathelminthes, more especially to the Nematoda, though they cannot at present be directly included in any recognised class. They have been found only along the shore line, and at shallow depths off the coast, where they live on the rocky or stony sea-floor, among clumps of seaweed and shell-fish; and creep along by curious, looping movements like those of a leech. In this movement, they are assisted by adhesive setæ situated in rows on the undersurface of the body towards the posterior end, and in a fringe round the anterior margin of the "head-swelling." These setæ, and the enlargement of the anterior end of the body to form a head-like swelling, constitute two of the most prominent characteristics of the animal, by which it is distinguished from any other known worm. All the *Chætosomatidæ* are very small, rarely exceeding 1 mm. in length, and cannot be detected by the unaided eye.

HISTORICAL.

They escaped observation until 1863, when Claparède⁽¹⁾ discovered a single female specimen on the coast of Normandy. To this, he gave the name *Chætosoma ophiocephalum*.

Three years later, Metschnikoff found them in considerable numbers in the Mediterranean Sea, near Salerno; and, in 1867, published a brief description⁽²⁾ of a species differing slightly from that found by Claparède.

Between 1867 and 1881, four zoologists, Greef(3), Barrois(4), Panceri(5), and Levinsen(6) recorded the finding of *Chaetosoma* in such widely separated localities as the Canary Islands, Brittany, Ischia, and Greenland, but added little or nothing to the description given by Metschnikoff, though Panceri added another species, *C. tristicochaeta* Panceri. He himself considered this to be a new genus, to which he gave the name *Tristicochaeta inarimense*; but it is now thought that the difference on which he based his classification is not of generic importance. Nothing further is recorded of *Chaetosoma* for twenty-six years. Then, in 1907-1908, Schepotieff(7-8) published a brief, general account of the group, including a description of two new species, which he had found at Bergen and Naples. Seven years later, a short, systematic description of two additional species appeared in a paper by Southern in the Clare Island Survey Series(8).

I have not had an opportunity of seeing the original papers by some of the earlier workers(4-6), but Schepotieff states that they are all brief and superficial, and based almost exclusively on studies of whole preparations.

Levinson's description is not made clear by illustrations, and is so imperfect otherwise, that identification of the new species he reported is uncertain. According to Schepotieff(8), it is probably identical with *Chaetosoma tristicochaeta*. Greef(3) confines himself to the statement that he frequently found *Chaetosoma* in different localities on the coast of the North Sea and the Canary Islands, but, beyond a few new species (which he does not describe or name), he could add nothing of importance to Metschnikoff's description. His paper, on some remarkable forms of Arthropod- and Worm-Types, deals mainly with the consideration of the systematic positions of this and other genera, which he designates as remarkable creatures, new or incompletely described, which bear in themselves the characteristics of different classes of animals, without inclining, with any decision, to one or other of them. He considers that the study of these yet living transition-forms between different classes of worms offers a great attraction to investigators, and demands as complete an investigation as possible, from every point of view,

of their organisation and life-history. Schepotieff's papers(7-8) deal with what he terms "The Nematoid representatives of the microscopic fauna of the rocky sea-bottom," including, in this term, the *Desmoscolecidae*, *Echinoderidae*, *Chaetosoma*, *Rhabdogaster*, and *Trichoderma*. His description is based on collections made on the coasts of the Adriatic, the Gulf of Naples, and the fjords of Norway. In the latter place, he had made extensive dredgings on a submarine reef running across the Byfjord near Bergen, and obtained *Chaetosoma* in large numbers in the coast-zone (10-15 mètres), in the years 1903 and 1905.

In his first paper(7), he gives a brief description of the external features only, explaining that the internal organisation is very difficult to investigate, owing to the strong development of the external cuticle, and its impenetrability to reagents. A year later, 1908, he published a fuller account(8), including in it observations on the internal anatomy made by means of transverse sections of a single species, *Chaetosoma longirostrum*. This, apparently, was the first time a successful attempt had been made to section the worm. But the drawings are lacking in detail, and a much fuller description is required to complete our knowledge of the anatomy of this group. As yet, too, no work at all has been done on the life-history.

Until 1914, the *Chaetosomatidae* were not known to occur outside the waters of the North Atlantic and Mediterranean Seas, though Schepotieff expresses the opinion that they are cosmopolitan, and belong to the most numerous and most typical representatives of the microscopic fauna of the rocky sea-bottom. In that year, Professor Haswell found a few individuals of two new species in Port Jackson, N.S.W.; and, some time later, he drew my attention to them.

During the past year, I have collected and examined specimens of these, and two additional species from the sea-shore in the vicinity of Sydney. The present paper is a record of that work, and an attempt to follow Greef's advice(3), and give as complete an account as possible of the anatomy of these curious, little creatures.

MODE OF OCCURRENCE.

I have not found the *Chaetosomatidæ* anywhere in the great numbers mentioned by Greef (3) and Schepotieff (7), but I have not been able to make dredgings on the sea-floor at depths of 10-15 mètres, where Schepotieff found them to be most numerous in the Byfjord. My search has been confined to depths accessible from the shore, from lowwater-mark to 5-6 feet below it, obtaining material from this depth by means of a long-handled net, and a bucket.

Long and careful searching has revealed a few scattered representatives in most of the material collected from clumps of molluscs and seaweed in different parts of Port Jackson and Broken Bay, and along the ocean-shore between these two bays. Round Circular Quay, they are to be found in fair numbers on the growth on the jetties; but, in the very dirty water of Darling Harbour, they appear to be almost entirely absent. I found only one in a very large quantity of material collected from an old pile, 40 feet long, which had just been pulled up, this specimen coming from a depth of 16-18 feet below lowwater-mark. Further up Port Jackson than this, (a distance of some $4\frac{1}{2}$ miles from the ocean), I have not found any. In all, I have secured about 100 specimens as a result of collections extending over six to eight months in 1916 and 1917. The majority of these came from Circular Quay, Cremorne, and Vaucluse, in Port Jackson; and Lion Island and Pitt Water, in Broken Bay. Most of them, I have found at very shallow depths, a few actually above lowwater-mark, and all of them among the growth of Algæ, Sponges, Molluscs, etc., on rocks or piles. They do not appear to be present where the sea-floor is composed of pure sand or mud, nor in coralline zones.

METHODS OF COLLECTING EMPLOYED

The methods of collecting adopted varied only slightly with the different species. When dealing with large quantities of material, the clumps of seaweed, sponges, etc., were transferred to a large bucket of sea-water, broken up, and thoroughly washed. The fine mud in suspension in the water was washed off by means of a siphon-funnel, the mouth of the funnel dipping into the

bucket being covered by miller's silk, to prevent the escape of anything but the finest sediment. Fresh water was continually added, till that in the bucket became fairly clear. It was then poured off into another vessel through a coarse wire-sieve to get rid of the more bulky material (some of which was kept for later examination), and concentrated by siphoning or filtering off most of the water through miller's silk.

The constant choking up of the silk by the fine sediment caused a good deal of difficulty in the use of the siphon. The same difficulty was experienced in filtering, when the finer quality of miller's silk was used, but I was uncertain whether the coarser quality would catch the *Chaetosoma*. It was necessary, therefore, to keep the filtrate from the coarser silk, filter it through the finer, and examine the material caught on this, and the water which passed through it. I was also uncertain whether the washings given to the bulky material collected were effectual in detaching the worms adhering to the seaweed, etc.

Until these points were settled, it was necessary to make four separate examinations under the dissecting microscope of each lot of material.

- (1). Seaweed, shales, sponges, etc.
- (2). Material caught on coarser silk.
- (3). Material caught on finer silk.
- (4). Filtrate from the finer silk.

I have never found anything but finely suspended mud in No.4, and, so far, no *Chaetosoma* in No.3; so that I think the coarser silk, which filters much more rapidly, can be used with safety. When dealing with small quantities of material gathered along the shore, I shake and wash it thoroughly in a jar, and filter off the water directly through the coarser silk, without making use of the siphon. The material caught on the cloth is either washed into a small dish of sea-water for immediate microscopical examination, or fixed for later examination.

Whether the washing is effective or not, seems to depend on the species of worm present. *Notochaetosoma tenax* clings so firmly to any support, that it is most difficult to detach it. I had found several worms of this species in material which had

been fixed before washing, but six hours' search through a second lot of material (fresh) from the same spot yielded only a single specimen. A careful examination of shells and seaweed revealed the living worms still clinging to them, after a very thorough washing. It is most difficult to detect the worm against the dark background of seaweed, so that, unless living specimens are required, the material collected is fixed before washing. With *C. haswelli*, there is not the same difficulty, as they wash off much more readily.

METHODS OF PREPARATION.

Various fixatives have been tried—formalin, sublimate-acetic, Carl's, glycerine-alcohol, and 70% alcohol, hot and cold. Formalin or sublimate-acetic, which for bulk-fixing are the most convenient, seem to give as good results as any.

Stains used in the preparation of whole mounts include Erlich-hæmatoxylin, picro-hæmatoxylin, picro-carmin, borax-carmin, and para-carmin. The picro-stains give very poor results. Erlich-hæmatoxylin and borax-carmin seem to be the most satisfactory; but the worm requires prolonged immersion in these, especially in the first, owing to the thickness of the cuticular covering. The length of time required varies with the species; three or four days for the species which have a very thick cuticle.

Clearing is a very difficult process, as most clearing agents, unless very carefully applied, shrivel and distort the animal. The more delicate *C. haswelli* mounts well in glycerine-jelly, when cleared for some time in glycerine-alcohol (glycerine, 10%; alcohol, 90%) under a bell-jar; but for the species with thicker cuticle, clove-oil or cedarwood-oil must be used, and the mounting done in Canada balsam. I have found clove oil the best, but it is necessary to add it very gradually, drop by drop, to the absolute alcohol, bringing up to pure clove-oil only after a day or two.

For section-cutting, the double embedding, paraffin-celloidin method was used. A few worms were embedded direct in paraffin, after clearing in cedar-oil, but the result was unsatisfactory; as was also the case when a celloidin-block was dispensed with, the worm being transferred direct from $\frac{1}{2}\%$ celloidin-solution to

chloroform. In these cases, the handling of the minute specimens was a great difficulty. In all cases, I found it necessary to stain the worm slightly before embedding, in order to locate it with the dissecting microscope when cutting out the celloidin or paraffin block.

The mounted sections were afterwards double-stained with Erlich-hæmatoxylin and eosin. Satisfactory sections are difficult to obtain. *Chaetosoma haswelli* is so delicate, that the body-walls tend to fall together during the embedding process; and, when this occurs, the transverse sections take the form of a narrow thread, in which it is impossible to make out details of internal structure. *Chaetosoma falcatum* and *Notochaetosoma tenax*, which have a very thick, external cuticle, and, consequently, a firmer outline, sometimes give good transverse sections, but they tend to tear out of the block, especially in longitudinal section.

For many of the specimens examined, I am indebted to Professor Haswell, whom I have to thank for the direction of the work, and in whose laboratory it was carried out.

I have also to thank Acting-Professor S. J. Johnston for the valuable assistance he has given me in the preparation, both of the material and the paper; and Mr. R. J. Tillyard for his kindly and helpful criticism and interest during the progress of the work.

STRUCTURAL FEATURES OF THE CHÆTOSOMATIDÆ.

All the *Chaetosomatidæ* have an elongated, cylindrical, worm-like body, tapering posteriorly to a sharply pointed tail, and usually swollen anteriorly to form a more or less distinct head.

For purposes of classification into genera and species, the distinguishing features are the shape and size of the head-swelling, and the extent of its demarcation from the trunk; the character of the pharynx; the number of rows of ventral and head-setæ, and their position; the character of the setæ; the relative proportions of the trunk; the thickness of the external, cuticular covering; the variations in the character of the transverse striations, and in the size and arrangement of the body-hairs with

which it is beset; and the general shape which the worm tends to assume, when fixed.

In all species hitherto described, the head-area is clearly distinguishable into three regions.

(1). The frontal part, known as the rostrum, on which the cuticle is not striated. This, as a rule, bears the anterior "head-hairs" or setæ, and a pair of curious, laterally situated, spiral grooves.

(2). The middle part, always the narrowest of the three regions, which is ringed by cuticular striations, much coarser and more strongly marked than on any other part of the body.

(3). The hinder part, only distinguishable from the trunk by its greater thickness, and the "neck"-constriction which marks it off from the latter.

But in two of the New South Wales species now described, there is little or no demarcation of a head-region. The pharynx lacks the typical, swollen "bulbs," and, in consequence, the anterior end of the body is very little, if at all, enlarged. The worm can be distinguished from a Nematode only by the rows of ventral setæ, and its characteristic creeping mode of locomotion.

The absence of a head-swelling would seem to suggest that these worms are more nearly allied to *Rhabdogaster* (2, 10) than to *Chaetosoma*. But, in the general structure of the body, they differ considerably from *Rhabdogaster*, and are very similar to other species of *Chaetosoma*. There is no median constriction of the trunk; the ventral setæ are stout, hollow rods, with distal segments, not delicate and crook-like, as in *Rhabdogaster*; and the female genital pore and genital organs are situated in the anterior, not the posterior half of the body.

I have, therefore, placed these two worms as a new genus, *Notochaetosoma*, in the family *Chaetosomatidæ*. The typical rostrum is present in both species of *Notochaetosoma*, but there is no special "banded" area of coarsely striated cuticle behind it. This banded area is also absent in one of the New South Wales species of *Chaetosoma*, described as *C. falcatum*.

The number of rows of ventral, locomotor setæ is of considerable systematic importance. All four New South Wales species

have four rows. Of the *Chaetosomatidae* hitherto described, three species have two rows; three species, three rows; and two species, four rows. It has been suggested that these three types should be placed in three distinct genera.

The number of setæ in each row varies in all cases with the age of the animal, and is, therefore, not altogether a specific character; but the relative extent of the body covered by the rows varies considerably in the different species, as does, also, the character of the setæ.

Two species have been described in which the setæ are all simple; in the others, either the setæ are all compound, with a small distal segment, or both simple and compound setæ are present.

In all species, the part of the trunk on which the setæ are situated serves as a sole, the ventral setæ become firmly attached to some support; and the worm rears itself up and stretches the anterior part of its body forward, when about to move. Schepotieff states(7) that it then attaches itself, and draws itself forward by means of mouth-teeth. But in all cases in which I have been able to observe the *Chaetosomatidae* alive, it is the dorsal 'head-hairs,' or setæ arranged in a semicircle on the hinder part of the rostrum, which perform this function. In the case of *N. tenuis*, I have been able to make out small, distal segments on the dorsal setæ, very similar to those on the ventral setæ. The adhesive power of these setæ seems to be very great, and the animal can only detach itself by a sharp jerk after each forward-movement.

The character and arrangement of the trunk-hairs varies considerably in the four New South Wales species. In *Ch. falcatum*, they are so short and scattered as to be hardly noticeable; while, in *Ch. haswelli*, they are very long and prominent, and are markedly swollen at the base.

The internal organisation is simple. There is a body-cavity, and the alimentary canal is a simple, straight tube extending through the body from the mouth, at the anterior end, to the anus on the ventral surface close up to the posterior end of the body. A glandular mass, lying dorsal to the posterior end of

the alimentary canal, and opening by a pore at the posterior extremity of the tail, is evidently excretory in function. Glands of some kind are also present in the head-region of some, if not all, the species, lying above the pharynx. They appear to be connected with the hollow, dorsal, locomotor setæ.

Some species show traces of a nervous system, in the shape of an ill-defined ring round the pharynx. The peculiar, lateral grooves on the rostrum are probably sense-organs of some kind. In the possession of a 'tail-gland,' and these lateral grooves, the *Chætosomatidæ* resemble many free-living, marine Nematodes. The resemblance is discussed in the detailed description of *Ch. falcatum*.

The sexes are separate. In the male, a single, simple tube extends from the anterior region to open with the rectum at the anus, and two, equal, penial setæ are present. The female sexual organs consist of paired ovaries, anterior and posterior, each opening by an oviduct into a common uterus. The female genital pore is situated on the ventral surface, about or in front of, the middle of the body. The ova are relatively few, and fairly large; and the animal appears to be oviparous.

DESCRIPTIONS OF THE SPECIES.

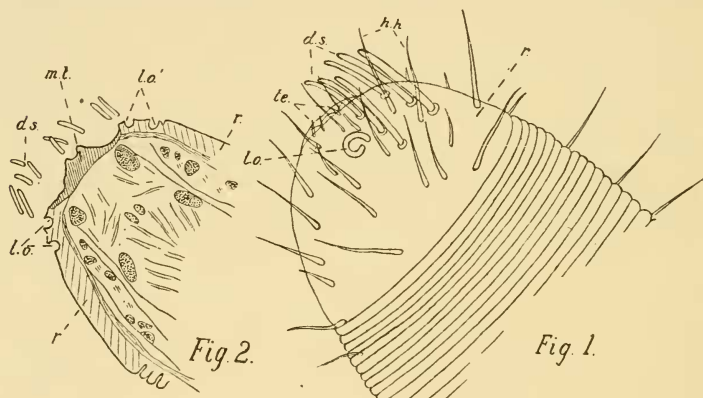
CHÆTOSOMA FALCATUM, n.sp. (Plates xlv.-xlvi.).

A few individuals of this species were found in 1914, by Professor Haswell, in material collected at Cremorne, Port Jackson; and the majority of the specimens, which I have obtained since, have come from the same locality. I have obtained only four specimens elsewhere; one in material from Vacluse, in which, also, I found *N. tenax*; and three from the rocks between tide-marks at Long Reef, a very exposed portion of the ocean-coast. At Cremorne, they were all taken from among the growth of shells and seaweed on a vertical rock-face, at a depth of from 4.5 feet below low water mark. They are scattered very sparsely through the material, and the search for them is a lengthy one, necessitating a preliminary fixation; and I have not yet been able to obtain any living specimens.

Ch. falcatum is an elongated, approximately cylindrical, worm-like animal, greyish-white in colour. In length, it does not

exceed 1.10 mm., and proportionally it is unusually broad, the trunk, in the largest specimens, attaining, at its widest part, a width of 0.092 mm. Dorsal and ventral surfaces are recognisable, and anterior and posterior ends. Anteriorly, the body is enlarged to form a head-like swelling (Pl. xlv., *hd.*) marked off from the trunk by a well-defined neck-constriction (Pl. xlv., *nk.*). Posteriorly, the trunk terminates in a short, sharply pointed, downwardly directed tail (Pl. xlv., *tl.*). The mouth-opening (*m.*) is anterior and terminal, and the anus (*a.*) is situated on the ventral surface, a short distance in front of the tail (0.06 mm. to 0.09 mm., according to the length of the animal). The sexes are separate, and, in the female, the external genital aperture is situated on the ventral surface, a little in front of the middle of the body (Pl. xlv., ♀, *g.p.*). When fixed, the animal usually assumes the shape of a query-mark, or a sickle, the anterior half of the body being strongly arched, with the concavity of the arch directed ventrally; while the posterior half is straight, or only very slightly bent in the opposite direction (Pl. xlv.-xlv.). The female genital aperture is situated close to the beginning of the anterior arch, in the region where the body attains its greatest width. Even in sexually immature worms, the anterior half of the trunk is always slightly wider than the posterior half, which is further distinguished by the presence, along the whole length of its ventral surface, of four longitudinal rows of stout, locomotor rods or setæ (Pl. xlv.-xlv., *i.r.*, *o.r.*). The whole body is enclosed in a thick, opaque cuticle, which, except at the extreme anterior and posterior ends, is divided up by close-set, transverse grooves, into numerous minute annuli or striæ (Pl. xlv.-xlv., *cut.*). The grooves are broad, and penetrate to nearly the full depth of the cuticle (Text-fig. 12, *cut.*). For the most part, they encircle the body in parallel lines, but, occasionally, adjoining grooves anastomose. On no part of the head or trunk is any variation in the size and thickness of the striæ to be recognised. The head-swelling is large in proportion to the size of the trunk, attaining a length of $\frac{1}{4}$ th to $\frac{1}{3}$ th that of the trunk; and a breadth usually slightly greater than the average breadth of the trunk. It is elongated-oval in shape, and is bluntly

rounded off anteriorly. Here, for a length of about one-fourth the total length of the head, the cuticle is devoid of striae, and is beset with numerous, very long hairs (Pl. xlv.-xlv.; Text-fig.1). Three transverse rows of setæ are arranged in a semicircle far forward on the dorsal side of the rostrum. The corresponding setæ of the three rows are in line, and form portions of longitudinal rows; the remaining portions of which are formed of unmodified hairs, extending from the junction of the striated cuticle with the rostrum, to its anterior margin (Text-fig.1, *d.s.*). A second row, consisting entirely of unmodified hairs, is inserted close beside each of these rows (Text-fig.1, *h.h.*). The hairs are



Figs.1-2.—*Chætosoma falcatum*, n.sp.

Fig.1.—Surface-view of rostrum, showing arrangement of hairs and setæ; ($\times 630$).

Fig.2.—Longitudinal section through the rostrum in the plane of the lateral sense-organs. The cut ends of the dorsal setæ show above the section; *m.t.*, tissue surrounding the mouth; *te.*, mouth-setæ.

For other lettering in these and other legends, see *postea*, under Explanation of Plates.

long and slender, having an average length of 0.022 mm., and taper to a fine point. They project vertically up from their point of insertion in the rostrum, but the setæ, which are stout and blunt, and about 0.015 mm. long, are inserted by broad bases in depressions in the cuticle; and are strongly arched forward and downward, bending over the anterior margin of the

head, and forming a semicircular fringe above the dorsal side of the mouth-opening (Text-fig. 2, *d.s.*). These 'setæ' probably correspond to the hinder head-hairs described by Schepotieff (7-8) for other species of *Chatosoma*, but do not correspond in position with either the hinder circle of head-hairs or the frontal head-hairs mentioned by him. Unmodified hairs, similar to those on the rostrum, 0.022 to 0.026 mm. long, occur on the posterior part of the head, and appear to be arranged more or less regularly in longitudinal rows. The cuticle of the rostrum stops short of the extreme anterior end (Text-fig. 2, *r.*), leaving a circular aperture through which the body-tissue projects in a lip-like arrangement surrounding the mouth. On this, there is a circle of very minute hairs or setæ (Text-fig. 1, *te.*), apparently six to eight in number, but, on account of the extremely small size of all these parts, details are difficult to determine with accuracy.

On either side of the rostrum, very close to the anterior margin of the cuticle, there appears a curious cuticular marking in the form of an open, spiral groove, the open end being directed posteriorly (Text-figs. 1, 2, *l.o.*). Similar cuticular markings are mentioned by Metschnikoff (2) and Schepotieff (7-8) as occurring on all species of *Chatosoma* hitherto recorded. Schepotieff seems to think they are peculiar to the *Chatosomatidae*, and compares them (7) with the wing-like head-appendages of the *Desmoscolecidae*. But I have seen similar markings on some small marine Nematodes, and Bastian has figured them in some of the illustrations to his monograph on the *Anguillulidae* (11), notably on *Comesoma vulgaris*, though he does not mention them in his description. De Man, in his 'Nordsee Nematoden' (12), also records them as occurring in *Enoplus*, *Oncholaimus*, *Anticomus*, and *Tripyloides*, in conjunction with the "paired lateral organs," which, he suggests, may be either excretory or sensory in function. So far as I have been able to determine, they are purely superficial cuticular structures. I cannot detect any sign of ducts leading away from them, nor any connection with the deeper layers of the body. But it is possible that such connection does occur, being difficult to detect on account of its extreme minuteness.

Immediately behind the 'head,' the trunk is sharply constricted to form a narrow 'neck' which is less than one-third the width of the head (Pl. xlv.-xlv., *nk.*). Behind the neck, the trunk rapidly broadens to its widest part in the anterior region of the body, becoming slightly narrower again in the posterior region, which bears the locomotor rods. The terminal portion of the trunk, distinguished as the 'tail,' is very short in this species,

being not more than 0.051 mm. long in the largest individuals. While devoid of striæ, its cuticle is not quite smooth, being minutely pitted all over (Pl. xlv., fig. 2*a*; Text-fig. 3, *tl.*). A few, very fine hairs are scattered over the surface of the trunk (Pl. xlv., *tl.h.*). These are never more than 0.007 mm. long, except towards the posterior end, where three or four pairs of much longer hairs occur on the dorsal surface. The last and longest of these, 0.026 mm. long, are inserted very close together just at the junction of the striated trunk-region with the tail (Text-fig. 3; Pl. xlv., xlv., *e.h.*). The ventral rows of locomotor setæ extend from behind the anus nearly half-way up the trunk, to the beginning of the anterior curve. The number of setæ in each row varies with the size and

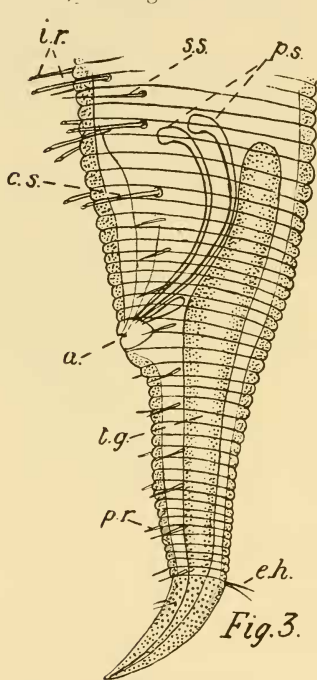


Fig. 3.—*Ch. falcatum*.

Posterior end of male; ($\times 520$).

age of the animal; but the relative extent of ventral surface covered by them remains about the same in specimens varying in length from 0.528 mm. (the smallest) to 1.104 mm. (the largest obtained by me). The two inner of the four rows are situated close together along the middle of the ventral surface, each row consisting of from 12 setæ in the smaller to 23 in the larger

individuals (Pl. xlv., xlv., *i.r.*). The setæ (0.018 mm. to 0.022 mm. long) are all compound, each consisting of a stout, tubular rod inserted by a broad base in the cuticle, bearing, at its distal end, a very small, leaf-like, movably-jointed segment (Pl. xlv., fig. 2*b*). They are separated by fairly wide intervals posteriorly, but are more closely crowded anteriorly, especially in the older individuals. In front of each inner row, and directly continuous with it, there are, in individuals of all ages, three or four, small, simple setæ of the same length (0.007 mm.) as the trunk hairs lying in front of them (Pl. xlv., *s.*). The trunk-hairs continue the ventral rows to the anterior end of the trunk (Pl. xlv., *t.h.*). The two outer rows of locomotor setæ begin, as a rule, about three setæ further back than the inner rows (Pl. xlv., *o.r.*), and are situated ventro-laterally, separated by a fairly wide interval (0.018 mm.) from the inner rows. In the male (Pl. xlv.), they consist of simple and compound setæ, alternating fairly regularly, there being, in the adult worm, about twelve compound and seven simple setæ in each row. The compound setæ (*c.s.*) are quite similar in size and character to those of the inner rows; the simple setæ (*s.s.*) are the same length, but are very slender and taper to a fine point. In the female, the outer rows are composed entirely of compound setæ, about twenty-one in number in the adult (Pl. xlv.). The inner rows cease before the anus, but the outer rows are continued back on either side of it, almost to the junction of the trunk with the tail. In the female, the postanal portion of the row consists of three or four compound setæ exactly like those further forward (Pl. xlv., fig. 2*a*). But, in the male, the compound setæ stop some little distance in front of the anus, and the posterior portion of the row consists of eight or nine simple setæ, shorter than those between the compound setæ, but stronger, stouter, and very sharply pointed. The last pair are frequently inserted right on the tail-point (Pl. xlv., fig. 1*a*). They appear to correspond closely with the double row of setæ present in the region of the anus, in some of the free-living marine Nematodes, where they constitute one of the external characteristics of the male. They are described by Bastian (11) for the genera *Anticoma*, *Enoplus*, and *Comesoma*; and in greater

detail by De Man(12), for several species of these genera, *e.g.*, *Enoplus communis*, in the male of which are found, "between the anus and the aperture of the accessory organ, eighteen setæ on each side of the ventral middle line."

In the adult female, the trunk is circular in cross-section in front (Text-fig.5), slightly flattened dorso-ventrally into a more oval form in the region of the genital organs (Text-fig 20), and posteriorly is broadly ovate (Text-fig.15), the narrowest part lying between the ventral locomotor setæ. The cuticle, which

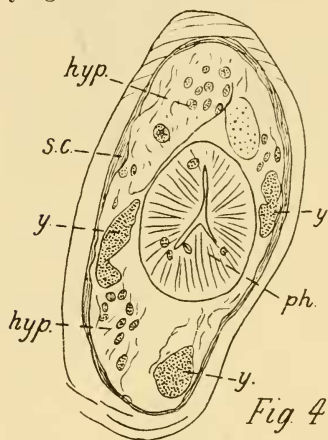


Fig 4

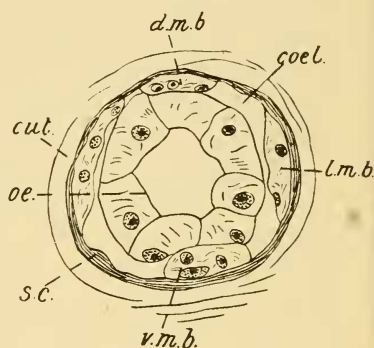


Fig 5

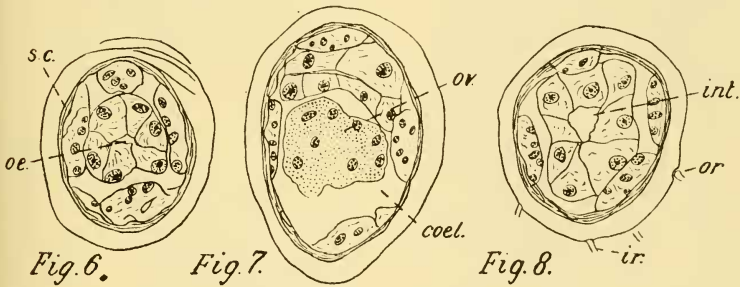
Figs.4, 5.—*Ch. falcatum*

Fig.4.—Transverse section through head in the region of the anterior pharyngeal bulb; ($\times 610$).

Fig.5.—T.S. through anterior part of trunk of same specimen; ($\times 610$); *hyp.*, hypodermis; *s.c.*, subcuticular layer of body-wall; *l.m.b.*, lateral mesodermal band; *y.*, glandular masses round pharynx.

forms the external covering of the body, is structureless, and quite homogeneous. It forms a relatively broad layer (0.004 mm., in a worm which has an average diameter of 0.048 mm.), and is of uniform thickness throughout (Text-figs.5-8, *cut.*). Beneath the cuticle is a much narrower layer (*s.c.*), in which it is impossible to make out any definite structure. It is strongly refractive, and appears bright yellow in sections stained with hæmatoxylin and eosin. Its internal outline is very irregular, both

in transverse and in longitudinal sections, due to variations in its thickness. In places, it projects into the body-cavity in the form of sharply angular thickenings (Text-fig.20, *s.c.*), but these thickenings are not constant in position, and there is no indication whatever of definite longitudinal lines in it. No cell-boundaries and no nuclei are visible within it, but scattered nuclei may occasionally be seen, lying along its inner surface (Text-fig. 12*a*). Four very definite thickenings of mesodermal tissue lie along the inner surface of this, and are respectively dorsal, ventral, and lateral in position (Text-fig.5, *d.m.b.*, *v.m.b.*, *l.m.b.*). They extend throughout the length of the trunk, from the neck-constriction to the beginning of the tail-region, forming four longitudinal ridges on the body-wall (Text-figs.12, 13). They appear to consist of a clear, net-like protoplasm, containing



Figs.6-8.—*Ch. fulcatum*.

Tr. secs. through trunk of a young specimen, showing the four, large mesodermal ridges on the body-wall, and the structure of the alimentary canal; ($\times 830$).

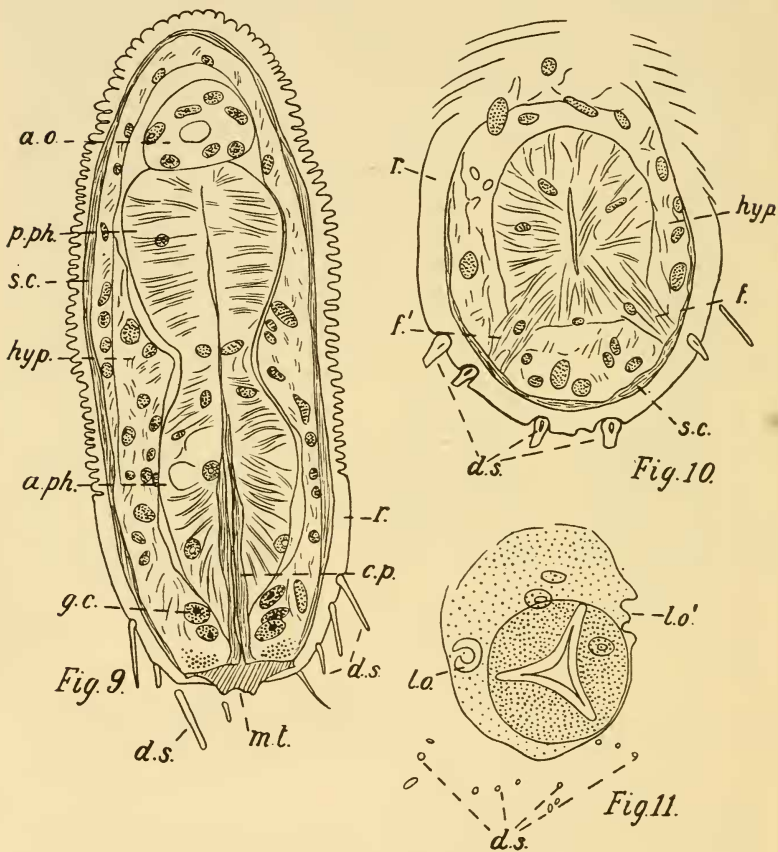
Fig.6.—Section through anterior region.

Fig.7.—Section through middle region, showing rudiment of genital system.

Fig.8.—Section through region of the ventral setae.

granules and nuclei, the latter being crowded along the inner surface of the ridge. These ridges are most clearly distinguishable in a young and immature worm, where they are relatively much larger than in the adult (Text-figs.6-8). In a worm, in which the alimentary canal and genital organs completely fill out the coelomic cavity, and press closely against the body-wall

in the middle region of the body, the ridges, especially the lateral ridges, are only recognisable as thin strands containing a few



Figs. 9-11.—*Ch. fulcatum*.

Fig. 9.—Horizontal, longitudinal section through head; ($\times 830$).

Fig. 10.—T.S. through rostrum, showing insertion of dorsal setae.

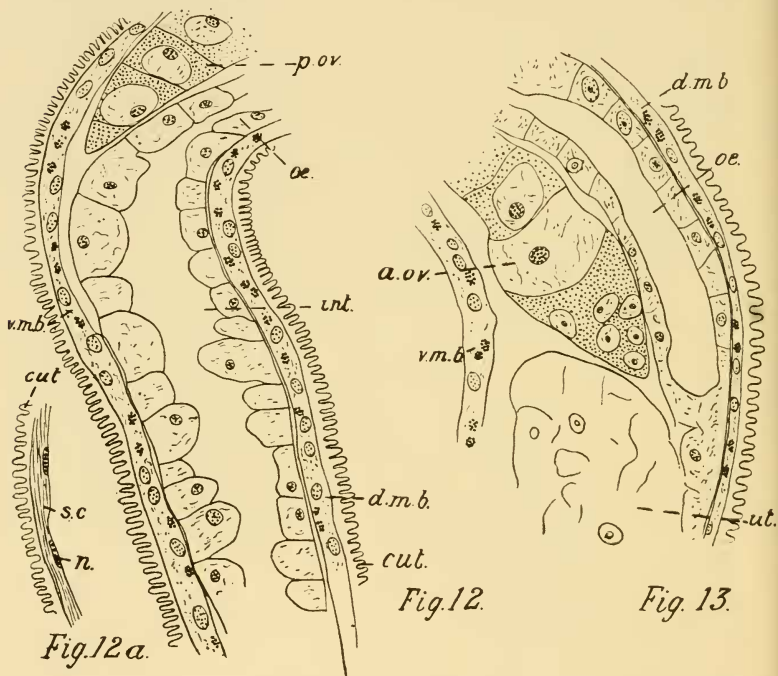
Fig. 11.—T.S. through anterior extremity of head, showing mouth-opening, and cut ends of dorsal setae; *c.p.*, cuticle lining pharynx; *f, f'*., bands attaching pharynx to body-wall; *g.c.*, glandular cells surrounding anterior end of pharynx; *m.t.*, tissue surrounding mouth-opening.

deeply stained nuclei and granules (Text-figs. 14, 15). The dorsal

ridge is more definite in outline and appears to be in contact with the alimentary canal throughout its length. In the head, the space between the pharynx and the body-wall is almost completely filled out with a loose, hypodermal tissue (Text-figs.9, 10, *hyp*), but, in the trunk, a definite cœlome is present, between the enteric canal and the body-wall. In the young worm, this space is relatively large, and extends uninterruptedly from the neck to the tail-region, where it is again filled out with protoplasmic tissue. But, in the adult, it is extensive only in the region of the œsophagus (Text-fig.5, *cœl.*). Further back, it becomes almost completely occluded by the growth of the genital organs and intestine. The enteric canal is a straight tube running through the length of the body, from the mouth, at the anterior end, to the anus near the posterior end. By variations in its width, and in the thickness of its walls, it is distinguishable into pharynx, œsophagus, intestine, and rectum.

The three-rayed mouth-opening (Text-fig.11) leads, through a very short and narrow passage, into a rounded bulb with thick, muscular walls, the anterior pharyngeal bulb (Text-fig.9, *a.ph.*). Its narrow cavity is rayed in cross-section, and is lined by cuticle (*c.p.*) which, everywhere thick, is thickest in the anterior portion, where the lumen is slightly larger than it is further back. Its walls are composed of a complicated system of circular, longitudinal, and radial muscle-fibres. Bands of muscle-fibres (Text-fig.10, *f, f'*.) attach its anterior end to the cuticle of the body-wall dorso- and ventro-laterally, and further back, towards its posterior end, there appear to be finer strands of fibrils running forward to attach it laterally. The anterior pharyngeal bulb extends through a little more than one-third of the length of the head, and is followed immediately by a second rounded swelling of equal length and width, the posterior pharyngeal bulb, the walls of which are composed of a less complicated system of radial muscle-fibres. Its lumen is still very narrow, and is lined with cuticle (Text-fig.9, *p.ph.*). It is divided by a well-marked constriction from the œsophagus, which is slightly swollen in the head-region to form a third, much smaller bulb (Pl. xlv., *a.o.*). This, however, differs from the pharyngeal bulbs in having non-

muscular walls, and a fairly wide cavity not lined by cuticle (Text-fig.9, *a.o.*). Behind the neck-constriction, the œsophagus extends back to the region of the genital organs as a cylindrical tube of uniform diameter, occupying a large part of the space enclosed by the body-walls (Text-fig.5, *œ.*). In an adult female



Figs. 12-13. — *Ch. falcatum*.

Fig. 12. — L.S. through female, in region of ventral setae; ($\times 610$).

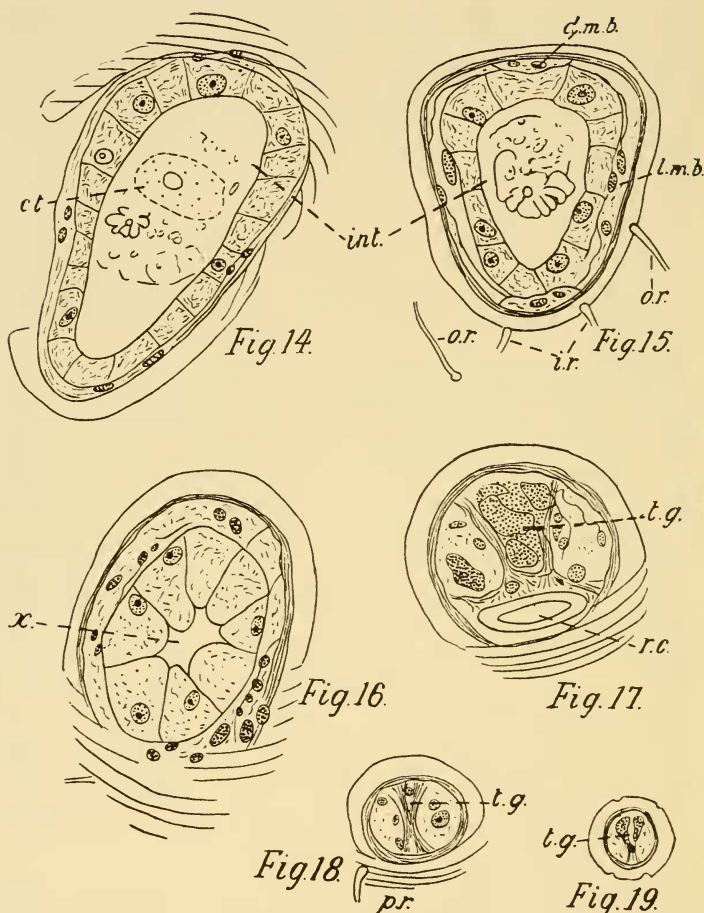
Fig. 12a. — L.S. through body-wall between the mesodermal bands, showing the subcuticular layer with nuclei (*n.*).

Fig. 13. — L.S. through body in region of anterior ovary and uterus. At the back of the uterus, the section passes through wall of intestine only.

worm, which is 0.055 mm. in cross-section, the diameter of the œsophagus is 0.033 mm. The walls are relatively thick, and composed of a single layer of large, rectangular cells, with thin

but easily recognisable walls and loose, granulated protoplasm. Each cell contains a large, oval nucleus, having a single, more darkly staining nucleus in it. There are from six to eight cells in cross-section. Further back, the entire canal becomes crushed up against the dorsal body-wall by the growth of the genital organs, and the walls become thinner (Text-figs.12, 13, 20-22, *æ.*). Behind the genital pore, where it passes backward to the left of the posterior ovary, its walls are very thin, and the cell-boundaries and nuclei are difficult to distinguish, while the protoplasmic contents become denser (Text-figs.23-24, *æ.*). Vacuoles (Fig.24, *v.*) and numerous rounded bodies, staining deeply pink with eosin, are present.

Immediately behind the posterior ovary, at the level where the first setæ of the ventral rows appear, it completely fills up the coelomic cavity (Text-figs.12, 14, 15, *int.*). Here, the walls are still thin, so that the lumen is relatively very large, and this part of the canal may, perhaps, be regarded as a stomach. The walls increase in thickness as it passes back, though still formed of a single layer of from 15-20 cells, which vary considerably in size. A short distance in front of the anal aperture, it passes suddenly into the rectum through a narrow passage surrounded by eight or nine very large, wedge-shaped cells with clear, protoplasmic contents, and large, round nuclei (Text-fig.16, *x.*). Behind the constriction, the walls are extremely thin (Text-fig.17, *rc.*), the passage is dorso-ventrally compressed, and lined with cuticle, and the anus, by which it opens on the ventral surface, is a transverse slit situated on a slight projection. A good deal of food-matter is present in all parts of the enteric canal in the adult worm, but it consists of a kind of granular *débris*, in which it is difficult to recognise anything definite. I have seen, however, a Desmid, a small Foraminiferal shell, and several chains of minute Algal cells among the *débris*. In an immature female worm, the cells forming the wall of the enteric canal are relatively very large, and few in number; and the lumen is very small, in parts almost completely closed-up (Text-figs.6-8). Surrounding the anterior end of the pharynx, there is a group of large cells staining deeply blue with hæmatoxylin, which pro-

Figs. 14-19.—*Ch. fulcatum*.

Series of Tr. Sees. through trunk of female from middle region to tail; ($\times 610$).

Fig. 14.—An oblique section through body, just behind posterior ovary.

Fig. 15.—Section in region of ventral setae.

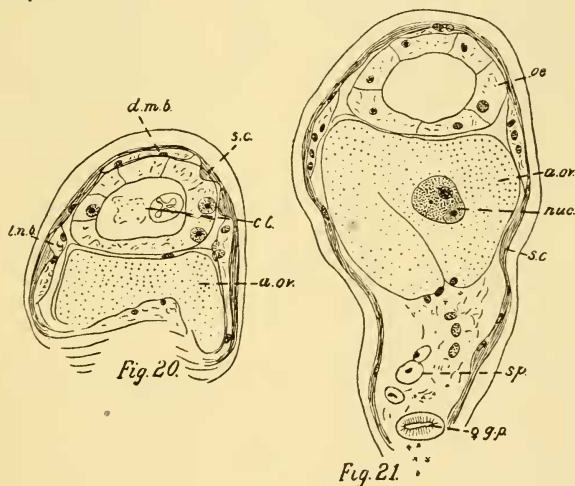
Fig. 16.—Section in region of constriction (c.) between intestine and rectum.

Fig. 17.—Section just in front of anus.

Fig. 18.—Section behind anus.

Fig. 19.—Section through tail; c.t., contents of intestine.

bably function as digestive glands (Text-fig. 9, *g.c.*), and in addition, there are several granular masses of a yellow colour embedded in the hypodermal tissue immediately surrounding the mouth, which may be glandular. Possibly the pink-stained bodies and the vacuoles in the wall of the stomach have a glandular function. In addition, there is a large, granular mass of tissue, staining deeply blue with hæmatoxylin, situated immediately above the rectum (Text-figs. 3, 17-19, *t.g.*). It occupies most of the space between the dorsal wall and the rectum, and extends as a longitudinal strand into the tail-region, opening by a duct at the extremity of the tail. This may correspond to the tail-gland described in many marine Nematodes, and thought to be excretory in function.



Figs. 20-21.—*Ch. falcatum*.

Fig. 20.—T.S. through body of female at beginning of anterior ovary; ($\times 450$).

Fig. 21.—Very oblique section through region of female genital aperture, showing portion of anterior ovary and uterus.

There is no trace of the longitudinal lateral vessels found in Nematodes, and the only indication of a nervous system is in the shape of an ill-defined granular mass of tissue round the constriction between the two pharyngeal bulbs.

In the female, there are two ovaries lying in the cœlome below the enteric canal, one behind, and one in front of the genital aperture (Pl. xlv., *a.ov.*, *p.ov.*). They are thick and short (about 0.066 mm. long), and the free end of each appears to be bent over on the remainder. The portion of each furthest removed from the genital pore, consists of finely granulated substance in which a few, very large nuclei are scattered (Text-figs. 20-21, *a.ov.*). The remaining part is divided by distinct walls into large cells, each

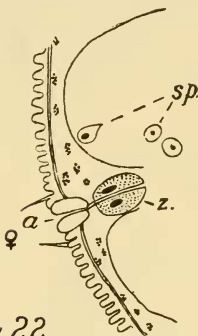


Fig. 22.

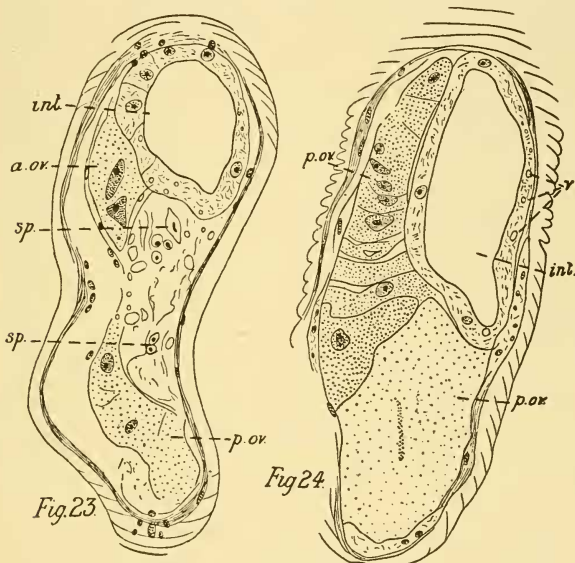
Fig. 22.*

passage (Text-fig. 22). Embedded in the wall of the uterus, and lying free in its cavity, are numerous rounded spots, stained bright pink with eosin.

In the male, the genital apparatus is in the form of a straight tube, lying ventral to the alimentary canal, throughout a greater part of the length of the trunk (Pl. xlv.). It is distinctly divided into three portions. At the anterior end, beginning 0.055 mm. from the neck, is the testis (*t.*), a narrow cord consisting of a solid mass of granular matter not divided into cells. Further back, cells become gradually differentiated, and pass into a wide, tubular cavity, the vas deferens, where they lie loose. At the level of the anterior end of the rows of ventral setæ, the vas deferens passes very abruptly into a narrow,

* L.S. through female genital aperture (*a.*), showing the large cells (*z.*) surrounding the passage into the uterus; ($\times 610$); *sp.*, sperms in uterus.

thick-walled duct, the vesicula seminalis (*v.s.*), which runs back to open with the rectum at the anus. At the junction of the vas deferens with the vesicula seminalis, the wall of the latter is very thick, opaque, and finely granular, and probably functions as a gland for secreting a seminal fluid. The lumen of the vesicula seminalis is difficult to make out. In all fixed specimens, it is filled with what is probably a coagulated fluid. The sperms are small and rounded, with a very distinct nucleus, but show no trace of the characteristic tail of the typical sperm.



Figs. 23-24.—*Ch. falcatum*.

Fig. 23.—Oblique section through middle region of trunk of female, showing portion of uterus, and anterior and posterior ovaries; ($\times 450$).

Fig. 24.—Section through the same worm, a little further back, showing cellular portion of posterior ovary (*p. ov.*); *sp.*, sperms in uterus; *v.*, vacuoles in wall of intestine.

Two, equally long, curved, penial setæ, and a small, accessory piece lie dorsal to the rectum. The setæ are bow-shaped, and have enlarged, proximal ends (Text-fig. 3, *p.s.*). Between the sperm-duct and the ventral body-wall, there is a row of block-

like, granular bodies, staining deeply blue with hæmatoxylin. Similar structures appear to be present in the female, connected with the ventral ridge of protoplasmic tissue. They probably have some relation to the locomotor setæ, though I cannot find any trace of communication between them.

Type-specimens, Nos. W, 452, 453; in the Australian Museum, Sydney.

Chætosoma falcatum, n.sp. Measurements in mms.

	♀	♂
Total length	0·888	0·840
Length of head	0·144	0·168
Length of trunk	0·744	0·672
Length from tip of tail to anterior end of rows of ventral setæ	0·408	0·360
Length from tip of tail to anus	0·092	0·077
Length of tail	0·051	0·033
Length from neck to ♀ pore	0·312	—
Greatest width of head	0·063	0·063
Greatest width of trunk	0·092	0·081
Width at level of ventral setæ	0·048	0·055
Width at level of neck-constriction	0·026	0·026
Length of rostrum	0·040	0·033
Length of setæ on rostrum	0·018	0·015
Length of hairs on head	0·022	0·022
Length of ventral setæ	0·018-0·016	0·018-0·016
Number of setæ in ventral rows—outer...	21 compound.	12 compound, 7 simple, 9 anal.
Number of setæ in ventral rows—inner...	23 compound.	17

CHÆTOSOMA HASWELLI, n.sp. (Plates xlv. xlvii.).

In 1914, Professor Haswell obtained a few individuals of this species from material collected along the shores of Port Jackson and Broken Bay, N.S.W. These were the first of the *Chætosomatidæ* found south of the Equator. In the following year, he drew my attention to them, and afforded me the opportunity of examining these and other specimens, which he subsequently collected. During the last twelve months, I have myself collected some fifty of the same species from various localities round the shores of these bays, and along the ocean-coast in the vicinity. *Ch. haswelli* appears to be the most generally dis-

tributed of the New South Wales species. I have found it in the same material with each of the other three species; and, in addition, at nearly every spot, where a search has been made, to a distance as far up the harbour as Circular Quay, and to a depth of 18 feet below lowwater-mark. No collections were made at a greater depth than this; and the majority of the specimens were obtained just below tide-marks.

I have been able to observe a fairly large number of living individuals. In one case, all the specimens were found alive in material which had been collected four days previously. Two were kept alive for fourteen days in a crystal-dish, by changing the water every day; and were then accidentally crushed during an examination under the microscope. A third worm, a young specimen, was kept alive for five weeks; and was still active, and apparently quite healthy, when it was lost during transference to fresh seawater. It had not then reached mature size. All the specimens found alive were very dirty, being covered with grit. They required frequent cleaning with a very fine camel's hair brush, as it was found that they continued to accumulate grit every day during the time they were alive, the dirt apparently adhering to a sticky secretion over the whole surface.

Ch. haswelli is the largest of the species found here. The length of the largest male obtained was 1.32 mm., and of the largest female, 1.44 mm. Sexual organs had not developed in the smallest specimen found, which was 0.60 mm. long. The worms are mostly S-shaped when fixed (Pl. xlv.). They are long and slender, and narrower, in proportion to their length, than the other species. The females are, on an average, longer than the males; and, in both sexes, the head is broader than the average width of the trunk. In the male, there is very little variation in the width of the trunk, though there is a slight increase in size in the middle region. The female is markedly wider in the middle. Typical measurements are given in the accompanying Table p. 798).

The head is oval in shape, and well marked off from the rest of the body. In length, it is only one-ninth to one-tenth of the

total body-length. The tail is fairly long and slender, tapering gradually to a fine point; and is longer in the male than in the female. The body is covered by a thin, delicate, semitransparent cuticle, which is marked by very delicate, transverse striations, except at the two extremities, where it is quite smooth; and in

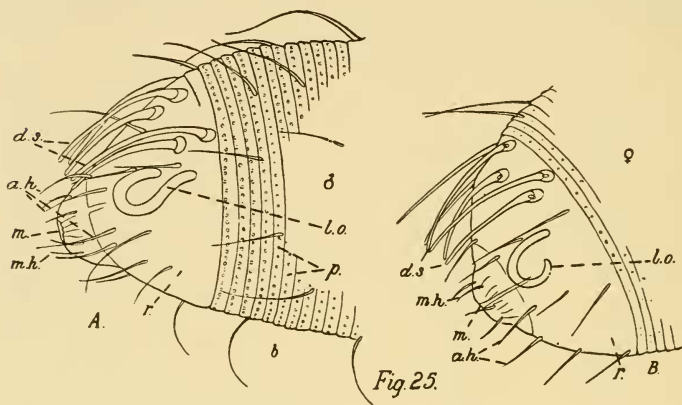


Fig.25.—*Ch. haswelli*, n.sp.

A., Anterior extremity of head of male, showing details of structure of rostrum (*r.*), and banded area (*b.*), lateral view.—B., similar view of head of female, to show difference in form of lateral sense-organ (*l.o.*); ($\times 630$); *m.h.*, hairs surrounding mouth; *a.h.*, terminal hairs of the rows extending down the trunk; *p.*, pores in the striae of banded area.

the middle region of the head, where there are from eight to fifteen much thicker ridges, forming a well marked band. The head, therefore, is distinguishable into three regions, a smooth, anterior end or 'rostrum' (Pl. xlv., *r.*); a banded area (*b.*); and a broader region behind it, on which the transverse striations are inconspicuous. The rostrum is short, about one-fifth to one-sixth the total length of the head, and is blunted off in front. The banded area is of about equal length, and appears to constrict the head, which broadens out considerably behind it. The ridges forming this band slightly overlap one another from behind forward (Fig.25, *b.*); and, in each ridge, continuing right round its circumference, there is a single row of fine pores set very

close together (Fig.25, *p.*). The pores are very deeply embedded (Fig.30, *p.*), but show, on the surface, as a row of fine, bright dots. They appear to be present only in this region, though the surface of the rostrum also is very finely, but irregularly, pitted all over.

The lateral, spiral grooves on the rostrum are large and conspicuous; the spiral is simple and very open, and is turned away from the dorsal hairs in the female, and towards them in the male (Fig.25, *l.o.*). Embedded in the hypodermis, below the groove on each side, is a peculiar cell, probably sensory in character (Fig.31, *x*), which may have some relation to these lateral organs, though I cannot trace any direct connection between them. The dorsal semicircle of stout 'head-hairs' or setæ, in the adult, consists of five or six pairs arranged in two rows close to the posterior margin of the rostrum (Fig.25, *d.s.*), the setæ of the posterior row being wedged against the most anterior of the ridges of the banded area. They have an average length of 0.025 mm. All the setæ are bent forward to such a degree, that they lie close to the surface of the rostrum, and follow its shape. They are enlarged at the base, and are long enough to project over the anterior end, where there is a lip-like arrangement surrounding the mouth (Fig.25, *m.*).

One immature female, without a genital pore, was found, in which there were only four setæ in a single row (Pl. xlvii., *b.*). In this case, the two inner setæ were inserted very close together in the dorsal mid-line; and the outer ones, separated from them by a fairly wide interval, are just dorsal to the spiral groove on each side. Close to the outer side of each seta is a long, fine hair.

The ventral setæ (Pl. xlv., *i.r.*, *o.r.*) are confined to a small portion of the trunk, usually about one-seventh the total length of the body, whether this is 0.60 or 1.44 mm. The setæ are arranged in four rows, beginning some little distance in front of the anus, about 0.051 mm., in mature worms of both sexes, and 0.034 mm., in young worms.

The two inner rows are situated very close together, and con-

sist each of 14-17 compound setæ (Figs.26, 27, *i.r.*, *i.r'*). The composition of the outer rows differs in the two sexes. In the female (Fig.27, *or.*), there are 10-14 compound setæ in each row; in the male, 7-11 compound setæ, and 4-5 simple setæ alternating irregularly (Fig.26, *s.s.*, *c.s.*). In young worms, the number is

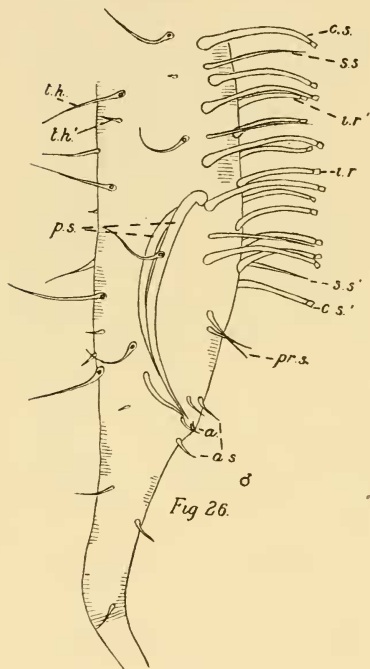


Fig 26.

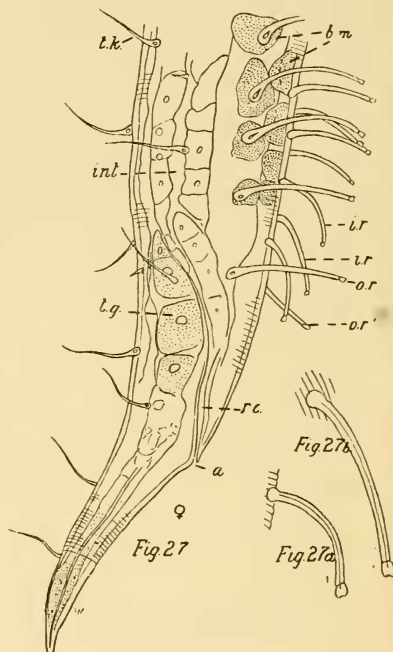
Fig.26.—*Ch. hasrelli*.*

Fig 27

Fig.27.—*Ch. hasrelli*.†

much less. In one specimen, which has only a single row of four head-setæ, there are five setæ in each outer row. Another young worm, 0.60 mm. long, which appeared to belong to this species,

* Posterior end of male, showing the arrangement of trunk-hairs and ventral setæ; ($\times 400$). The penial setæ are visible through the body-wall (*p.s.*); *a.s.*, setæ surrounding the anus; *pr.s.*, pre-anal setæ.

† Posterior end of female, showing the arrangement of hairs and setæ on the surface, and also some of the internal structure, as seen through the body-wall; ($\times 400$). Fig.27a.—Seta of inner row of ventral setæ; ($\times 630$). Fig.27b.—Seta of outer row; ($\times 630$).

had only a single row of head-setæ, and only three pairs of ventral setæ (Pl. xlvii., *b*). But it is possible that this was a damaged specimen, since the setæ in some of the others examined broke off with handling.

The setæ of the inner rows (Fig. 27*a*) are much shorter than those of the outer rows (Fig. 27*b*), which are often longer than the width of the body in that region; and longer in the male than in the female, averaging, in the former, 0.045 mm., and 0.040 mm. in the latter. The longest setæ are at the anterior end of the rows. Here, they are more closely crowded than they are further back. All the compound setæ are similar in character. Each consists of a proximal, elongated, hollow rod, and a small, expanded, movably-jointed end-segment, with a deep indentation in its distal margin. The simple setæ, which alternate with them in the male, are of equal length, but very slender and delicate, and tapering to a fine point. The body-hairs are a very conspicuous feature in this species. They are very long, relatively to the width of the trunk; and all have a bulb-like swelling at the base (Figs. 26, 27, 35, *t.h.*). They are arranged in eight longitudinal rows, two lateral rows on each side, two dorsal, and two ventral, which are all continued over the head to the anterior end of the rostrum (Pl. xlv.). The dorsal and dorso-lateral rows extend down to the margin of the tail, but the ventral and ventro-lateral rows only to the beginning of the ventral setæ, with the inner and outer rows of which they are respectively continuous. The number of hairs in each row is limited, and appears to be fairly constant. On the trunk, there are, in the dorsal rows, 20-30 long hairs; dorso-lateral rows, 19-27; ventro-lateral, 15-17; and ventral, 15-23. On the head, there are, on the hinder region, 3-5 hairs; on the banded area, two; and, on the rostrum, 3-4, the terminal hair of each of the eight rows being situated right at the anterior margin of the cuticle, so that there are eight hairs forming a circle surrounding the lip-like prominence, in the centre of which, the mouth is situated (Fig. 25, *a.h.*). Immediately round the small mouth-opening, there is another ring of small hairs, about six apparently,

but the number is difficult to determine (Fig. 25, *m.h.*). On the dorsal side of the rostrum, the rows of hairs are distinct from, and lie between, the stout 'dorsal hairs,' or setæ, already described. On the trunk, in each row, there are, alternating fairly regularly with the long hairs, very short, blunt hairs (Fig. 26, *t.h'*), which have a similar bulb-like swelling at the base. This, in all the hairs, seems to be hollow. Particles of dirt are frequently found adhering to the hairs, and it appears probable that these are glandular, and secrete some sort of mucilage. The 'long trunk-hairs' of the dorsal rows are longer than those of the other rows, especially over the region of the genital organs in the female, but the variation in length is not marked. In different specimens, the length varies from 0.025 mm. to 0.05 mm., and seems to average about two-thirds the average width of the body.

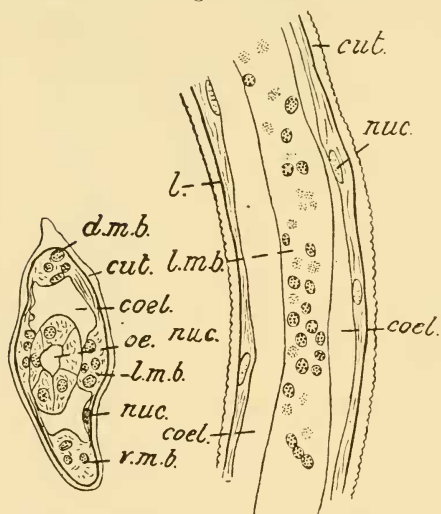


Fig. 28a.

Fig. 28.

Figs. 28, 28a.—*Ch. haswelli*.*

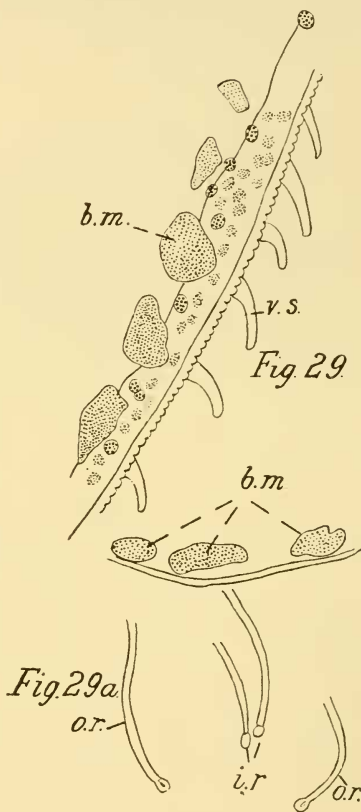
level of the anus and the beginning of the tail. The cuticle of

In the male, there are, in the region of the anus, several hairs differing in character from the ordinary trunk-hairs, stronger and stouter, and without the basal swelling. These appear to be very constant in position, *i.e.*, two inserted very close together about half-way between the outer, ventral row of setæ and the anus (Fig. 26, *pr.s.*), two on each side of the anus, one behind, and one in front of it, in the mid-ventral line (Fig. 26, *a.s.*), and one or two others between the

* Fig. 28.—L.S. through body-wall, cutting through one of the mesodermal bands, and the subcuticular layer on either side of it; ($\times 950$). Fig. 28a.—T.S. through anterior region of trunk of a young *Ch. haswelli*; ($\times 950$).

the body-wall is a thin, homogeneous layer, about 0.001 mm. thick (Fig. 28, *cut.*). An extremely thin, dark line (*l.*), which, however, becomes much thicker in the head, divides it from the next layer.

This is of about the same thickness as the cuticle. It is difficult to make out any structure in it, but it appears to be of fibrous composition; and, lying along its inner border, there are, at wide intervals, elongated, oval nuclei (*nuc.*). Below it, at about equally spaced intervals, there run four longitudinal bands of mesoderm, containing numerous, crowded, round nuclei (*d.m.b.*, and *l.m.b.*). These bands are continuous from the neck to the tail, and form the innermost layer of the body-wall. Within it is a wide coelomic cavity (*coel.*), in which lie the enteric canal and the genital organs. In the head, a loose sort of protoplasmic tissue fills up a great part of the cavity, between pharynx and body-wall. Below the ventral body-wall, in the region of the ventral

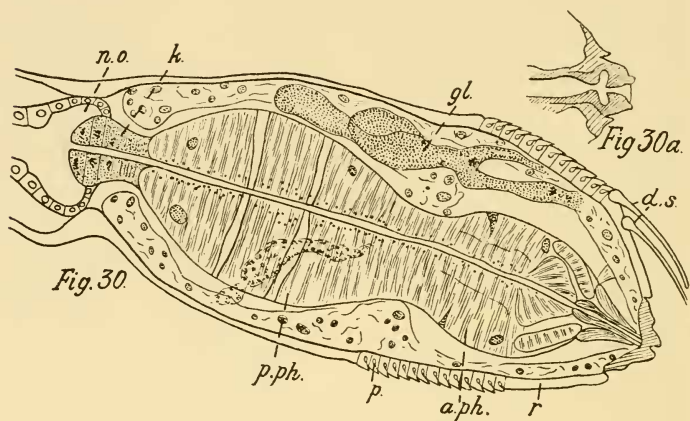


Figs. 29, 29a.—*Ch. haswelli*.*

setae, there are four rows of block-like, finely granular masses, staining deeply blue with hæmatoxylin (Pl. xlvii., *b.m.*). They are quite separate from one another, about ten to twelve in each

* Fig. 29.—L.S. through body-wall in region of ventral setae; ($\times 950$). Fig. 29a.—T.S. in same region; ($\times 610$). The section has been flattened out in cutting; *v.s.*, bases of ventral setae.

row; and they lie directly under the rows of locomotor setæ throughout their length (Figs.27, 29, *b.m.*). It is probable that they have some relation to the setæ, since they are found only in this region; but I cannot trace any direct connection between them.



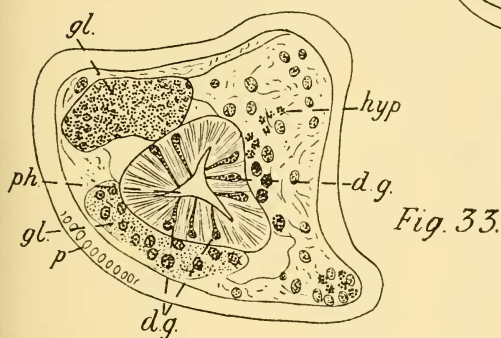
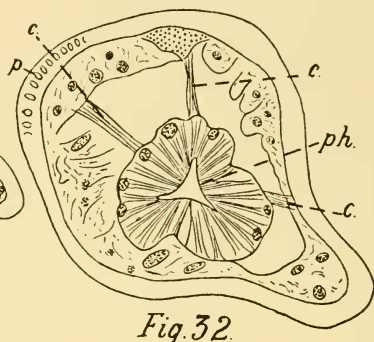
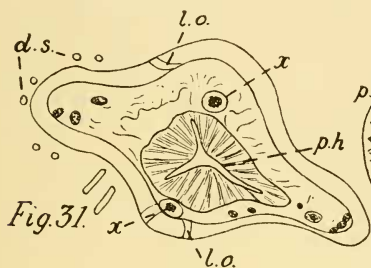
Figs.30, 30a.—*Ch. haswelli*.

Fig.30.—Sagittal, longitudinal section through head; ($\times 660$).

Fig.30a.—Section through mouth-opening; ($\times 760$).

The mouth-opening is surrounded by a circular projection, which seems to be protrusible, and bears a circlet of fine teeth (Fig.30a). The mouth leads directly into the pharynx, which has very thick, muscular walls, and extends through the full length of the head. It is constricted in the middle to form anterior and posterior bulbs, of which the posterior is the larger (Fig.30, *a.ph.*, *p.ph.*). Both bulbs are slightly larger in the female than in the male, corresponding to a difference in the size of the head. The walls of the anterior pharyngeal bulb consist of a complicated system of muscle-fibres, the arrangement of which is shown in Fig.30. The passage is narrow, and lined with cuticle, which is thickest towards the mouth-opening. Immediately surrounding the passage, there is a mass of finely pigmented granules; and deeply embedded in the muscle-fibres are numerous, small glands, probably digestive, which open into the

pharynx by fine ducts (Fig.33, *d.g.*). Strands of tissue connect the bulb with the inner wall of the rostrum, both at the anterior end and further back (Fig.32, *c.*). The muscle-fibres in the posterior bulb are all radial, and are divided into three sections by two radial gaps, which are very constant in position in different



Figs.31-33.—*Ch. haswelli*.

Series of tr. secs. through the head; ($\times 950$). The head has been distorted in shape during the process of embedding.

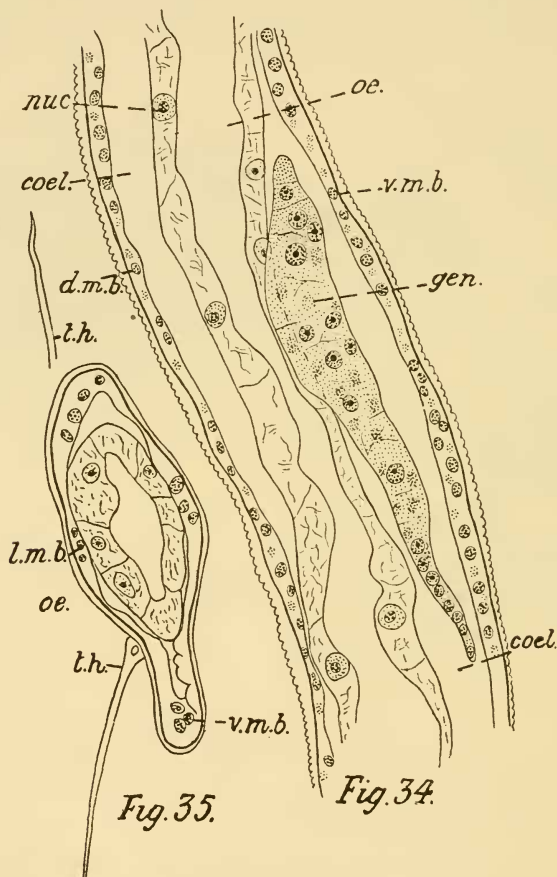
Fig.31.—Section through the rostrum.

Fig.32.—Section through the 'banded' area.

Fig.33.—Section through the hinder part of the anterior pharyngeal bulb; *x.*, sensory cells; *d.g.*, digestive glands; *p.*, pores in the striae of the banded area; *c.*, fibres from pharynx to body-wall.

specimens. This gives the appearance of a broad band surrounding the middle region of the bulb. The gaps contain a granular substance, which is probably glandular in character. The terminal portion of the pharynx consists of a knob (Fig.30, *k.*),

formed of a little group of dark granular cells, which projects into a wide, thin-walled chamber formed by a swelling of the œsophagus in the neck (Fig. 30, *n.o.*). This swelling is supported



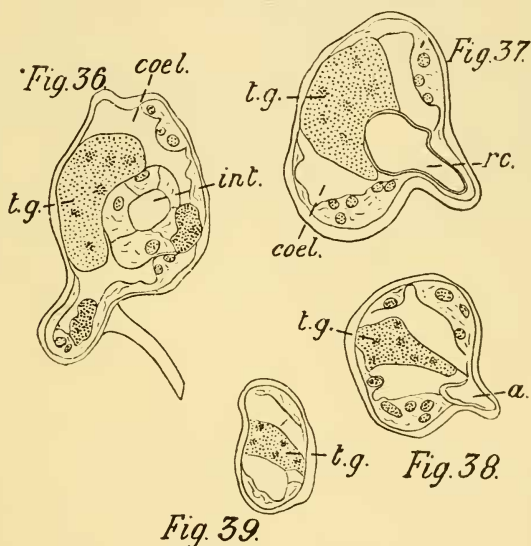
Figs.34-35.—*Ch. haswelli*.

Fig.34.—L.S. through trunk of a young specimen in middle region, showing rudiment of a genital system (*gen.*); ($\times 950$).

Fig.35.—T.S. through trunk anterior to genital system; ($\times 950$).

by inward projections of the body-wall. Behind it, the lumen of the œsophagus is narrow throughout its length, and the wall

is one cell thick (Figs.34, 35, *ae.*). The cells are thin-walled, and roughly rectangular in cross-section, measuring about 0.014×0.007 mm. The protoplasmic contents are clear; and a large, round nucleus (*nuc.*) is situated about the middle of each cell. In the mid-region of the body, in the female, the intestine is constricted to a narrow tube pressed up against the dorsal wall by the genital organs. Below the posterior ovary, it widens so as nearly to fill the coelome. The cells of the wall are here very large, and the cell walls, forming the lining of the passage, are



Figs.36-39.—*Ch. haswelli*.

Series of tr. secs. through posterior region. Like most of the transverse sections, they have become distorted in shape during embedding; ($\times 950$).

Fig.36.—Section through constriction between intestine and rectum. Fig. 37, through rectum. Fig.38, through anal aperture. Fig.39, through tail.

slightly thickened. The cells vary in shape, and project into the intestinal cavity, leaving only a narrow passage. The tube is constricted again in the region of the ventral setae (Fig.27, *int.*).

About the level of the last of the ventral setae, the intestine

passes, by a narrow constriction, into the rectum (Fig.37, *rc.*), a wide, thin-walled tube lined with cuticle. This opens by the anus (Fig.38, *a.*) on the mid-ventral surface, at an average distance of 0.080 mm., from the posterior end, in the female; and 0.099 mm., in the male.

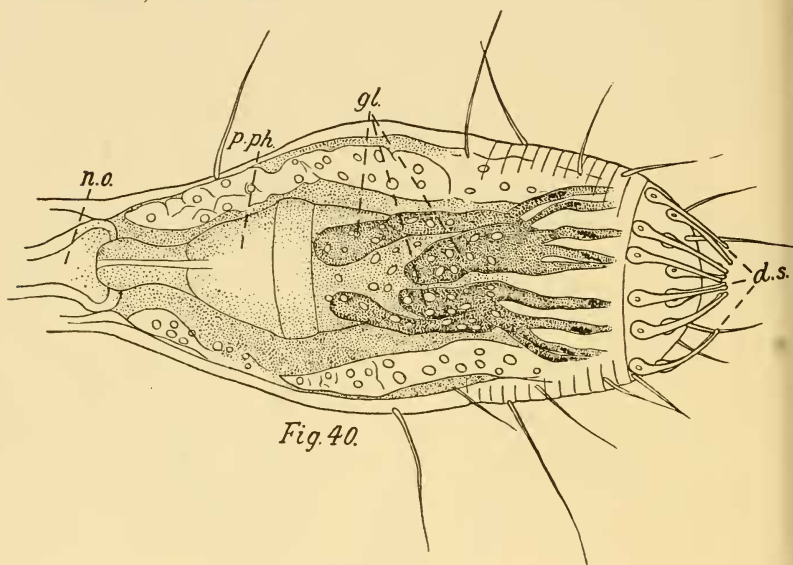


Fig.40.—*Ch. hasurelli*.

Dorsal view of head, showing arrangement of dorsal setæ, and the glandular bodies (*gl.*) lying above the pharynx; ($\times 660$).

Nerve-cells and nerve-fibres are distinguishable in the protoplasmic tissue in the head. They seem to form an ill-defined ring surrounding the constriction between the two pharyngeal bulbs, and give off strands forward and backward.

Lying above the pharynx, and embedded in the hypodermis, there is a group of densely granular bodies (Figs.30, 40, 41, *gl.*), staining dark blue, from each of which, a strand runs forward, and apparently connects with the base of one of the dorsal setæ. One or several thickenings occur in each of these strands, towards the anterior end. I have been able to observe these bodies only in a few specimens, and have failed to determine their exact

nature. The thickenings on the strands seem to suggest nerve-matter, but I think it more probable that they are glandular in character, and secrete a fluid which assists the hollow, dorsal setae in their locomotory function.

Another body, of a glandular character, lies in the posterior end of the trunk, just dorsal to the rectum. It is club-shaped, composed of several, large, finely granular cells containing numerous vacuoles and large nuclei, and is bounded by a distinct wall (Figs. 27, 36-39, *t.g.*). It is connected with

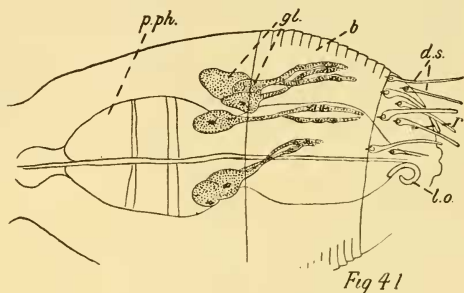


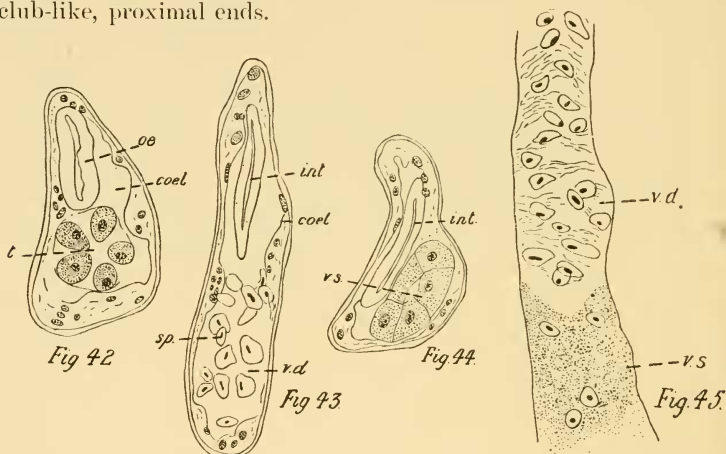
Fig. 41.—*Ch. haswelli*.

Lateral view of dorsal setae and glands (*gl*) in the head; ($\times 400$).

a fine duct, which runs back through the tail, and opens by a fine pore at the posterior extremity. Large, bright drops of fluid are distinguishable in the duct, in some specimens; it seems probable that this organ is an excretory 'tail-gland.'

In the male, the reproductive apparatus consists of a single cord, which begins at a distance of 0.074 to 0.140 mm., from the neck, and extends straight back below the alimentary canal, to open with it at the anus. The anterior portion is solid, and terminates in a fine point (Pl. xlvii, *t.*). It has an average width of 0.007 mm., and consists of a closely packed mass of small cells enclosed by a firm wall. Further back, the cells become larger and more loosely arranged, and take on the definite character of sperms, of rounded or somewhat irregular shape, with fragments of connective tissue between them (Figs. 42-43, 45). This portion, which has a width of 0.014 mm., passes abruptly, towards the middle of the body, into a definite tube, with very wide, cellular walls (Fig. 44, *r.s.*). The lumen is extremely small, and, in cross-section, is surrounded by four or five, large cells, with very large nuclei. In longitudinal section, it has the ap-

pearance of being a solid cord, but the dense, finely granular substance filling it, is probably a spermatic fluid, which has become coagulated in the fixing. It is impossible to examine it in the living state, owing to the difficulty of keeping the actively moving worm in the field, under a high power. Posteriorly, the sperm-duct diminishes in width. There are two, equal, penial setæ (Pl. xlvii.; Text-fig.26, *p.s.*), and an accessory organ. The setæ are long, and are curved into a bow-shape, with enlarged, club-like, proximal ends.

Figs 42-44.—*Ch. haswelli*, ♂.*Fig.45.—*Ch. haswelli*.†

The female genital pore (Figs.46, 47, ♀ *g.p.*) is a transverse slit, with prominent lips, situated on the ventral surface just about the middle of the trunk. There are two, large and well-developed ovaries (Fig.46, *a.ov.*, *p.ov.*) situated, one anterior and one posterior to the genital pore. The end of each, furthest from the pore, is roughly conical in shape, about 0.074 mm. long,

* Series of sections through the trunk; ($\times 630$). The sections have been laterally compressed, and the internal structure somewhat distorted. Fig.42—A section through the anterior part of testis. Fig.43, through the vas deferens. Fig.44, through the sperm-duct, in the region of the ventral setæ.

† L.S. through male genital tube, in region between the vas deferens and the vesicula seminalis, showing the finely granular matter in which the sperms are embedded at the junction; ($\times 630$).

and 0.026 mm. broad at the widest part; and contains large nuclei embedded in finely granular substance. It is continuous

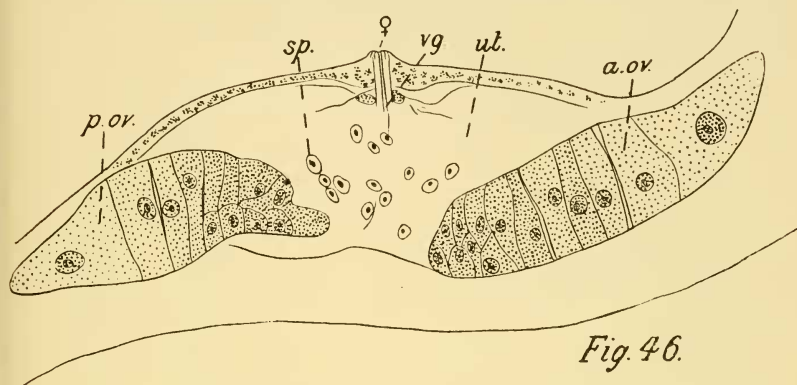


Fig.46.—*Ch. haswelli*, ♀. Genital system; (×400).

with a much broader portion, where there is a differentiation of the contained matter into long, thin cells, cut off in a transverse direction. There are distinct spaces between some of the cells, which appear to be ova in process of formation. This part may, perhaps, be looked upon as an oviduct. A definite, tubular duct, connecting it with the uterus, is not discernible in any of the specimens, which I have examined. Some individuals examined had a single, large, oval egg in the common uterus (Fig. 47, *o.*). The uterus measures 0.092 × 0.055 mm. A large receptaculum seminis seems to be a diverticulum from it. It lies to one side of the oviducts, and extends out towards the anterior and posterior ovaries. In all the specimens examined, it is full of sperms (Fig.46, *sp.*). The narrow passage, leading from the uterus to the vulva, has thick walls,

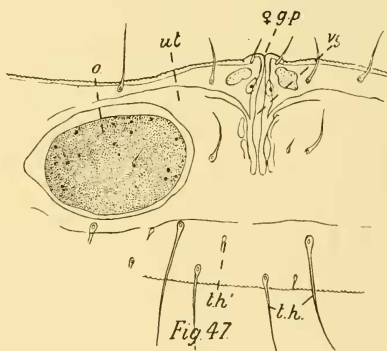


Fig.47.—*Ch. haswelli*. Ovum in uterus; (×320).

and, at its junction with the uterus, is surrounded by a few large cells, which probably act as a sphincter (Fig. 47, *vy.*). The development of the fertilised ovum has not been followed.

Type-specimens, Nos. W, 454, 455; in the Australian Museum, Sydney.

Chaetosoma haswelli, n.sp. Measurements in mms.

	♀	♂
Total length	1.39	1.128
Length of head	0.144	0.120
Length of trunk... ..	1.248	1.008
Length of trunk covered by rows of setæ	0.185	0.166
Length from tip of tail to ant. end of rows of setæ... ..	0.333	0.333
Length from tip of tail to anus	0.092	0.107
Length of tail	0.037	0.037
Length from neck to genital pore	0.600	—
Greatest width of head	0.070	0.066
Greatest width of trunk	0.085	0.059
Width at level of ventral setæ	0.047	0.030
Width at level of neck-constriction	0.029	0.033
Length of rostrum	0.026	0.022
Length of setæ on rostrum	0.022	0.022
Length of hairs on trunk	0.037	0.025
Length of ventral setæ, outer rows	0.044	0.055
Number of setæ in ventral rows—outer	13	7 + 4
inner	15	12

NOTOCHÆTOSOMA, gen. nov.

The two species, included in this genus, differ considerably from any of the Chaetosomatidæ hitherto described, in that a well marked head-swelling is absent. There is a corresponding difference in the structure of the pharynx, which lacks the typical pharyngeal bulbs, and is only slightly swollen posteriorly. The structure otherwise is very similar to that of the Chaetosomatidæ, but the differences indicated seem to be of sufficient importance to constitute a new genus of this family.

Genotype, *N. tenax*, n.sp.

NOTOCHÆTOSOMA TENAX, g. et sp. nov. (Plates xlviii.-xlix.).

Only a few specimens have, so far, been obtained, all taken from a single locality in Port Jackson. I first found four in the

winter of 1916, in material collected at Vacluse, on the rocks between, and just below tide-marks. Since then, about thirty worms of the same species have been obtained from the same place; but extensive searches, in other localities, have proved fruitless.

The ventral, adhesive setæ are very powerful, and it is difficult to dislodge the animal from its support, so that I have been able to observe only five living individuals. These were taken from the concentrated washings of some thirty jars of fresh material. Two of the worms were kept alive in a crystal-dish, with two changes of sea-water, for a period of eight days, and a third for nine days. They have the characteristic, creeping mode of locomotion of the Chaetosomatidæ; and are more easily distinguishable from marine Nematodes when alive, than after death. When fixed, the general appearance of the body so closely resembles that of a small Nematode, that it is only possible to detect them by means of the minute setæ on the head and ventral surface.

The largest individuals attain a size of 1.0 mm., but the average size is somewhat less than this, from 0.8 to 0.9 mm. Male and female appear to be of the same length. The shape assumed, when fixed, is not constant; but the posterior third of the body is usually straight, while the region in front is more or less arched in a dorsal direction. The anterior end is only slightly enlarged, and is distinguishable as a head-region by its curvature, rather than by any definite neck-constriction. It is usually more or less bent in a ventral direction, but the curvature varies considerably in different specimens, as will be seen in the Plates. The cuticle covering the body is very thick, and, from the rostrum to the beginning of the tail, is transversely striated. There is no special banded area behind the rostrum, the striæ being all broad and deep, of the same thickness all over the body, though there is a difference in character between the striæ of the head-region and those behind, the former overlapping one another, from behind forward, to a much greater extent than the striæ on the trunk (Fig. 53, *cut.*). The rostrum (Figs. 48, 53, *r.*), is short, 0.014 to 0.018 mm. long; and the smooth cuticle

covering it is very thick, and has a serrated anterior margin. Beyond it, is a projection of tissue, 0·011 mm. long, with a rounded extremity, in the middle of which the very small, circular mouth-opening (Fig. 48, *m.*) is situated. The width of the body, just behind the rostrum, is 0·040 to 0·050 mm., which decreases, at the level of the neck-curve, to a width of 0·033 to 0·037 mm. The length of this anterior, ventrally curved portion varies, in different individuals, from 0·122 to 0·150 mm. Behind it, the body gradually increases to a width, in the male, of 0·050 to 0·060 mm., and, in the female, in the region of the genital organs, of 0·070 to 0·096 mm.

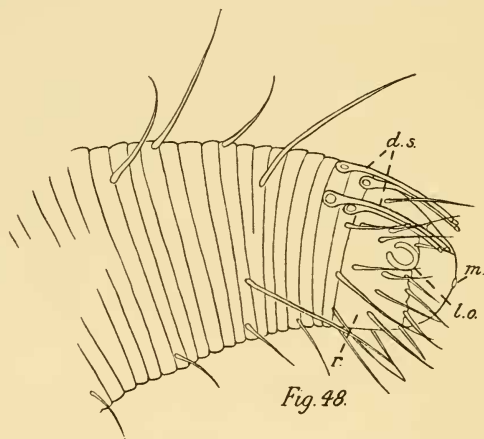


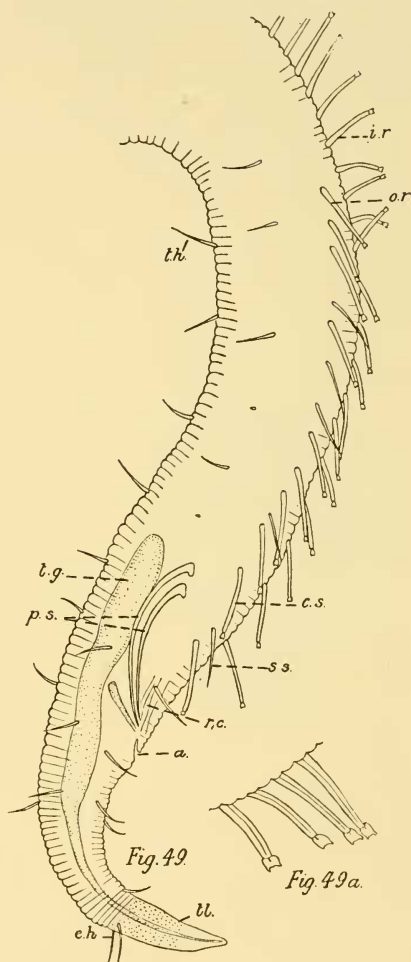
Fig. 48.—*Notochatosoma tenax*, n.sp.
Lateral view of anterior extremity; ($\times 630$).

The tail (Fig. 49, *tl.*) is narrow, and sharply pointed. In the male, it averages 0·085 mm. from anus to tip; in the female, 0·077 mm. Cuticular striations are absent from the terminal portion (0·040 mm. long), and the anterior half of this part is closely pitted. A pair of long hairs is inserted on its dorsal surface, just at its junction with the striated area (Fig. 49, *e.h.*). As in the other species, the anus is situated on the mid-ventral surface, close to the posterior end (Fig. 49, *a*). The ventral setæ are arranged in four rows, and cover a length of about one-sixth

to one-fifth the total length of the body. The rows begin about 0.045 mm. in front of the anus, and extend forward for a distance, which varies from 0.092 to 0.188 mm., according to the age of the animal, and the number of setæ. The outer rows (Figs. 49, 50, *o.r.*) are laterally situated, separated by a wide interval from the inner rows (*i.r.*), which are inserted very close together, and in pairs anteriorly. Further back, they alternate irregularly, and the two rows are not so clearly distinguishable. They usually begin further forward, and their setæ are much shorter than those of the outer rows.

In the male, the outer rows are composed of compound and simple setæ alternating irregularly, the simple setæ (Fig. 49, *s.s.*), being fewer in number, and shorter than the compound (*c.s.*), and very slender. Four

or five, short, simple setæ continue the outer rows back on either



Figs. 49, 49a.—*N. tenuis*, ♂.*

* Posterior region of trunk. The tail-gland and penial setæ are seen in outline through the body-wall; ($\times 386$).

Fig. 49a.—Compound setæ of ventral row; ($\times 630$).

side of the anus. The number varies, in the specimens examined, from seven compound and five simple, to fifteen compound and seven simple setæ. In the inner rows, the setæ are all compound, and vary in number from 10-17.

In the female (Pl. xlix.), all the setæ, of both outer and inner rows, are compound, and vary in number, from nine in the outer and ten in the inner, to twenty in the outer and twenty-two in the inner rows. All the compound setæ in this species are comparatively short and stout. The proximal segment is hollow;

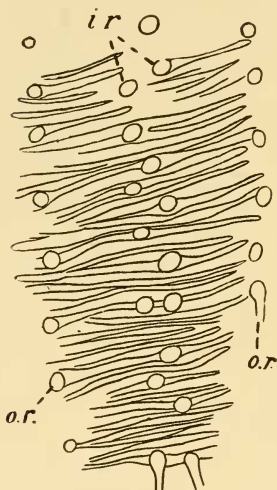


Fig. 50.

Fig. 50.—*N. tenax*.
L.S. through cuticle, and bases
of ventral setæ; ($\times 830$).

while the distal segment is very broad, with two, curious, lateral processes, which are very characteristic (Fig. 49*a*). In some of the younger specimens, two, distinct, inner rows of setæ are not fully developed. The head-setæ are not inserted on the rostrum, but immediately behind it, on the margin of the striated area (Fig. 48, *d.s.*). They are arranged in a semicircle on the dorsal side of the head; and, in most adult worms examined, are eight in number, forming two rows of four each. But, in one female specimen, there is a third row of two behind the other rows, the two being inserted in a line with the middle two of the rows in front. Several young specimens have only one row of four setæ, with a fine hair

inserted close to the outer margin of each. In one case, a second row appears to be just in process of formation, in front of that which is fully developed. In specimens deeply stained with hæmatoxylin, a small, jointed, distal segment is clearly discernible on each seta, the only case in which I have been able to distinguish this; though, in the other species examined, I have thought it probable that the head-setæ, as well as the ventral

setæ, were compound. The distal segment is much smaller than in the case of the ventral setæ, and can be seen only with the aid of an oil immersion lens. The setæ are hollow, and slightly swollen at the base. They are bent forward, arching over the rostrum, but do not reach quite to the anterior margin.

The trunk-hairs (Fig.49, *t.h.*) are short and slender, not more than 0.012 mm. long, and are not swollen at the base. They are arranged in eight longitudinal rows, the two rows on each surface, dorsal, ventral, and lateral, being situated close together. Each hair is inserted in a pit-like depression in the cuticle, from the base of which, a fine canal runs inward to the inner body-wall (Fig.51, *t.h.*). The rows extend over the rostrum to the serrated margin of the cuticle, where the terminal hairs form a circle surrounding the prominence on which the mouth is situated (Fig.48). The hairs become longer towards the anterior end (0.022 mm.), and are especially long on the rostrum, where there are three strong hairs in each row. Those on the ventral side of the rostrum are nearly as stout as the dorsal setæ, so that, under low magnification, they give the appearance of a circular fringe of stout hairs surrounding the anterior end. The ventral rows of trunk hairs are continuous with the rows of ventral setæ. The lateral grooves (Fig.48, *l.o.*) lie between the two lateral rows of hairs on each side of the rostrum. They are large, and horseshoe-shaped or hook-shaped, with the open end directed posteriorly.

On account of the toughness of the cuticle, satisfactory longitudinal sections are difficult to obtain, but some transverse sections show the internal structure fairly well. The thick cuticle (Fig.51,

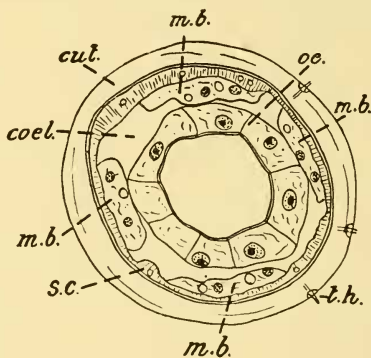


Fig. 51.

Fig.51.—*N. tenax*.

Transverse section through anterior region of trunk; ($\times 950$).

cut.) seems to consist of several concentric laminae. Within it, is a fine, structureless layer of uniform thickness, below which is a very irregular layer, which appears deep brownish-yellow in all sections which are double-stained with Erlich-haematoxylin and eosin. In places, this projects into the body-cavity, in the form

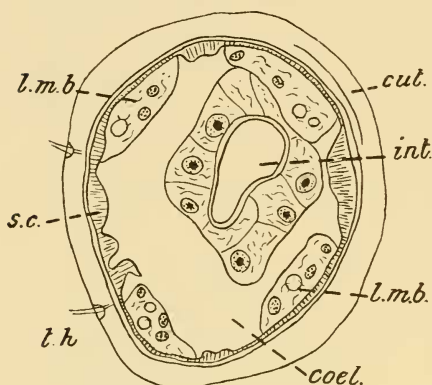


Fig. 52.

Fig. 52.—*N. tenax*.

T.S. through posterior region of trunk;
($\times 950$).

of thickenings, which have no regular arrangement (Fig. 52, *s.c.*). Extending along the inner surface of the body-wall throughout its length, from pharynx to anus, are four equally spaced ridges of mesodermal tissue (Figs. 51, 52, *m.b.*). Just behind the pharynx, these are very prominent, and consist of a loose, vacuolated tissue containing large nuclei. In the mid-region, the ridges are barely distinguishable,

but, towards the posterior end, they again become very prominent, especially the two lateral ridges, which are here very large, and enclose large spaces which, in places, are almost filled-out with fine granules, staining a deep pink with eosin.

The body-wall encloses a coelomic cavity (Figs. 51, 52, *coel.*), which is extensive in the anterior region of the trunk, but, further back, becomes nearly filled up by the alimentary canal and genital organs.

The alimentary canal extends straight through the body, from mouth to anus. The mouth leads into a muscular pharynx, which is elongated and slender (Fig. 53, *ph.*). The posterior end is slightly enlarged, but there is no definite bulb. Its walls are one cell thick, the cells being few in number, and very large, with a large nucleus in each. Round its anterior end, is a group of elongated, slender, yellowish bodies, which seem to open into the

mouth-cavity. They are probably digestive glands (Fig.53, *d.gl.*). The pharynx is separated from the remainder of the alimentary canal by a sharp constriction. Behind this, the canal soon widens out into a thin-walled tube (Fig.51, *a.*) formed of a single layer of large cells, from five to ten in cross-section, bounded internally by a fairly thick wall, apparently composed of cuticle. In side-view, the cells are pentagonal in shape, and very large. In the mid-region of the body, the alimentary canal becomes narrower, and lies dorsal to the genital organs (Fig.55, *int.*). At the level of the ventral setæ, it again widens (Fig.52, *int.*), and its inner wall is thickened. Posteriorly, the intestine passes into a wide rectum (Fig.56, *re.*) with thin walls of cuticle, which opens on the ventral surface by a narrow, transverse slit, the anal aperture (*a.*).

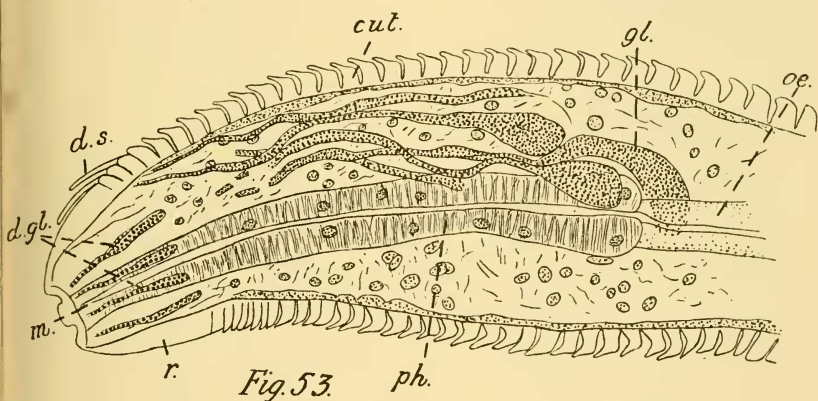


Fig.53.—*N. tenax*.

Sagittal, longitudinal section through anterior end; ($\times 830$).

A group of finely granular, somewhat pear-shaped bodies lies above the posterior end of the pharynx (Fig.53, *gls.*). From each of these, one or more strands run forward towards the anterior end. It is not possible, in any of the specimens examined, to trace them to their termination; but it seems evident that they end in the bases of the dorsal setæ, and that the bodies are glands supplying the setæ with some sort of fluid.

Lying in the mesodermal tissue, just below the ventral setæ, there are, in addition, several rows of block-like, granular masses (Fig. 56, *b.m.*), similar to those described in *Ch. haswelli*. They correspond fairly closely with the posi-

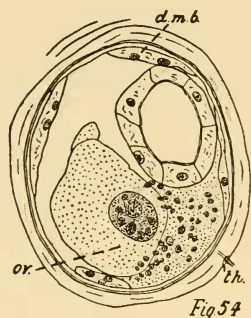


Fig 54

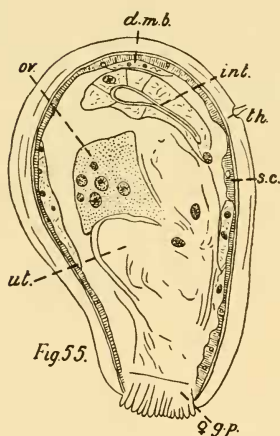


Fig 55.

Figs. 54, 55.—*N. tenax*, ♀.*

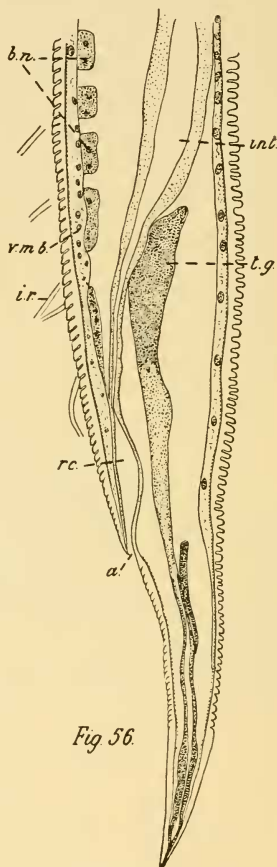


Fig 56.

Fig. 56. *N. tenax*, ♀.†

tion of the setæ, though they are fewer in number, as a rule. They do not appear to communicate directly with the setæ, and

* T.S. through genital region; ($\times 630$). Fig. 54.—Section through anterior ovary. Fig. 55.—Section through ♀ genital aperture, and uterus.

† Posterior end, as seen in longitudinal section; ($\times 550$).

I have not been able to determine their exact nature, but they evidently bear some relation to the setæ, and are probably glandular. A large and prominent tail-gland (*t.g.*) lies dorsal to the rectum. From this, a narrow duct, with very definite walls, runs backward to open by a prominent pore, situated at the posterior extremity of the tail. In several specimens, clear, oval drops may be seen lying in the duct.

The male genital apparatus (Pl. xlviii., *t.*) consists of a single, straight cord running through the body-cavity ventral to the alimentary canal. It begins towards the anterior end, and appears to open posteriorly into the rectum. Its anterior end consists of a solid mass of oval sex-cells in two or three closely packed rows. Further back, the sperms become gradually differentiated, and lie free in a wide tube, which passes abruptly, about the middle of the body, into a thick-walled passage, apparently filled with a solid, granular matter. There are two, equal, penial setæ (Fig. 49, *p.s.*) lying dorsal to the rectum. Each is a long, slender, curved rod, with an expanded, flattened, proximal end.

The reproductive organs of the female (Pl. xlix.) consist of two ovaries, anterior and posterior (*a.ov.*, *p.ov.*) which are connected by a wide, median uterus. The latter opens on the ventral surface, in front of the middle of the body, by a wide, transverse slit, with thick walls. The ovaries are straight, fairly elongated, and broadly spindle-shaped. Towards the uterus, each becomes divided into a single row of long, narrow cells, cut off in a transverse direction across it. It narrows as it approaches the uterus, and is here sharply pointed, the contained cells being smaller and more numerous. The uterus forms a receptaculum seminis which, in most specimens examined, contains sperms. None of the specimens examined contained ripe ova, and the development has not been followed out.

Type-specimens, Nos. W, 456, 457; in the Australian Museum, Sydney.

Notochaetosoma tenax, gen. et sp. nov. Measurements in mms.

	♀	♂
Total length	1·056	1·056
Length from anterior end to neck-curve ...	0·129	0·140
Length of trunk covered by rows of setæ ...	0·188	0·133
Length from tip of tail to anterior end of rows of setæ... ..	0·328	0·284
Length from tip of tail to anus	0·092	0·103
Length of tail	0·044	0·044
Greatest width at anterior end	0·048	0·048
Width at neck-curve	0·037	0·037
Greatest width of trunk	0·074	0·070
Width at level of ventral setæ	0·040	0·051
Width at beginning of smooth tail-part ...	0·014	0·014
Length of rostrum	0·025	0·025
Length of setæ on rostrum	0·022	0·023
Length of hairs on head	0·022	0·025
Length of hairs on trunk... ..	0·011	0·018
Length of ventral setæ, outer rows	0·022	0·026
Length of ventral setæ, inner rows	0·015	0·015
Number of setæ in ventral rows, outer... ..	18	8 compound } 7 simple }
Number of setæ in ventral rows, inner... ..	21	14 compound
Length of penial setæ	—	0·050
Length from anterior end to genital pore ...	0·432	—

NOTOCHÆTOSOMA CRYPTOCEPHALUM, gen. et sp. nov. (Plate l.).

In the same material from Vacluse, Port Jackson, in which specimens of *N. tenax* were obtained, I found a single male individual of another species, which very closely resembles it in general form. There is a total absence of a head-demarcation, and, in shape, the worm looks very like a Nematode (Plate l.). It is elongated and cylindrical, 1·056 mm. long, and tapers gradually towards each end. The anterior end is rounded; the posterior end terminates in a sharply pointed tail.

Four rows of ventral, locomotor setæ (Text-fig. 57) are present, beginning 0·048 mm. in front of the anus. The body is broken in the region of the setæ, so that the number of the setæ and the length of the body covered by them, cannot be determined with accuracy; but there are about seven compound setæ in each

outer row (*o.r.*), and eight in each inner row (*i.r.*, *i.r'*.); and the length of the rows is about 0.148 mm. The setæ are short, the inner shorter than the outer. They measure respectively 0.015 mm., and 0.026 mm. They are all rather slender, and taper distally. The end-segments are small and expanded, with two, small, lateral processes.

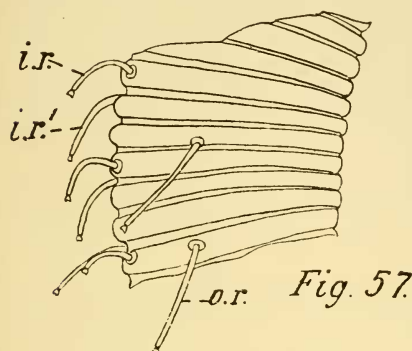


Fig.57.—*N. cryptocephalum*, n.sp.

Trunk in region of ventral setæ, showing the character of the striations on cuticle, Wales; and the transverse and the arrangement of the setæ; ($\times 650$). The striæ are very broad, with fairly wide intervals between them (Fig.57). They number about 200, and are of the same character and size all over the body.

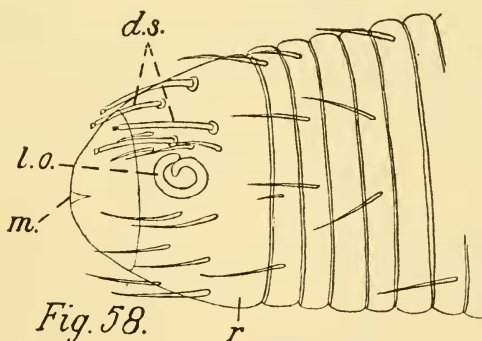


Fig.58.—*N. cryptocephalum*.

Lateral view of anterior end; ($\times 860$).

The smooth rostrum (Text-fig.58, *r.*) at the anterior end is 0.033mm. long. It bears two rows, each of four dorsal setæ(*d.s.*), about midway between the beginning of the striated area and

the anterior extremity. They are comparatively short, 0·015 mm., and do not extend over the anterior margin of the rostrum. There are no hairs or setæ on the posterior portion of the rostrum, but several rows of hairs lying ventrad of the dorsal setæ, which are almost as stout and as long as the setæ, are on a level with them, and are arranged in an exactly similar way. The hairs on the trunk are fine and short, not more than 0·007 mm. long, and are quite inconspicuous.

The lateral grooves on the rostrum (*l.o.*) are in the shape of a strongly curved spiral, with the opening turned towards the dorsal setæ.

The anus is a transverse slit, 0·140 mm. from the tip of the tail (Text-fig.59, *a*). It is surrounded by an oval, flattened patch of cuticle, which is finely pitted. Just behind it, two stout hairs are inserted, and bend over towards it.

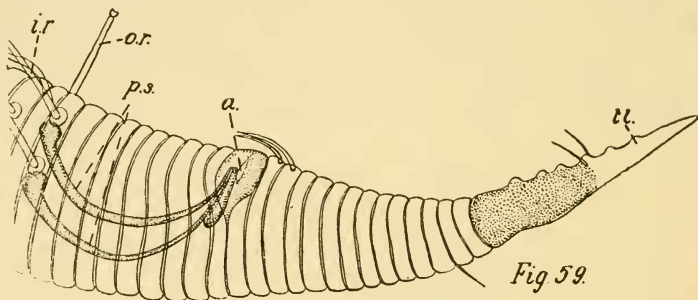


Fig.59.—*N. cryptocephalum*, ♂.

Posterior end; the penial setæ are seen through the body-wall; ($\times 480$).

The shape of the tail is peculiar. It is 0·066 mm. long, slender, and sharply pointed. The cuticle covering it is finely pitted for two-thirds of the distance to the tip, and, on the ventral side, it is raised into six sharp ridges or serrations, which give it the appearance of a saw (Text-fig.59, *tl.*). About midway along its ventral surface, there are two hairs inserted close together.

The cuticle is so thick that it is almost impossible to make out any details of the internal structure.

The alimentary canal (Plate I., *æ.*, *int.*) is a tube continuous

from the mouth, at the anterior, to the anus, near the posterior end, but the structure of its walls is not visible. The pharynx (*ph.*) is slender, with a slight enlargement at its posterior end.

The male genital apparatus (*t.*, *v.s.*) is just visible in outline, and appears to be very similar in structure to that of the other species described. Two, equal, penial setæ are present (Text-fig. 59, *p.s.*). They are 0.066 mm. long, and are very slender, and strongly curved, with enlarged, proximal ends.

Type-specimen, No. W, 458; in the Australian Museum, Sydney.

Notochartosoma cryptocephalum, gen. et sp. nov. Measurements in mms.

	♂
* Total length	1.056
Length of rostrum	0.033
Width behind rostrum	0.052
Width of narrowest part behind anterior end ..	0.048
Greatest width of trunk	0.066
Width in region of ventral setæ	0.048
Width at beginning of tail... ..	0.015
Length from tip of tail to anus	0.140
Length of tail	0.066
Length from anus to rows of ventral setæ ...	0.048
Length of body covered by ventral setæ... ..	0.148
Length of body-hairs	0.007
Length of dorsal setæ	0.015
Length of hairs on rostrum	0.011
Length of penial setæ	0.066
Length of ventral setæ, outer rows	0.026
Length of ventral setæ, inner rows	0.015

Key to the Genera of the Family *Chartosomatidae*.

- a.* Head-swelling well developed, and well marked off from the trunk by neck-constriction; pharynx enlarged in head-region to form one or more bulbs *CHARTOSOMA*
- aa.* No well developed head-swelling, and no definite neck-constriction; pharynx not enlarged in head to form bulbs.....
..... *NOTOCHARTOSOMA*.

Key to the Species of the Genus *Chartosoma*.

- a.* Not more than two rows of ventral setæ.
 - b.* Without head-setæ *C. ophioccephalum*.
 - bb.* With head-setæ.

- c. Setae of ventral rows compound *C. claparèdii*.
- cc. Setae of ventral rows simple, and very delicate... *C. macrocephalum*.
- aa. More than two rows of ventral setae.
- d. With three rows of ventral setae.
- e. Inadequately described species *C. groenlandicum*.
- ee. Recognisable species.
- f. Rostrum short and straight; head-setae poorly developed,
and not hook-like *C. tristicochaeta*.
- ff. Rostrum very long and sharply bent in a ventral direction;
head-setae well-developed and hook-like *C. longirostrum*.
- dd. With four rows of ventral setae.
- g. With a conspicuous band of transverse striae behind rostrum.
- h. With only one row of dorsal head-setae; rostrum provided
with spines. *C. spinosum*.
- hh. With more than one row of dorsal head-setae; rostrum not
provided with spines.
- i. With two rows of dorsal head-setae; trunk-hairs arranged
in eight longitudinal rows *C. haswelli*.
- ii. With three rows of dorsal head-setae; trunk-hairs arranged
in six longitudinal rows... .. *C. hibernicum*.
- gg. Without a conspicuous band of transverse striae behind rostrum.
- j. With three rows of dorsal head-setae; rows of trunk-setae
very long, extending halfway up trunk *C. falcatum*.

Key to the Species of the Genus *Notochaetosoma*.

- a. Dorsal head-setae not inserted on rostrum; tail not serrated.. *N. tenax*.
- aa. Dorsal head-setae inserted on rostrum; tail serrated along ventral
surface *N. cryptocephalum*.

All the figures, for both Plates and Text-figures, were drawn with the help of the camera lucida, the finished drawings being prepared by Mr. F. W. Aitkins, of the Technical High School, Sydney.

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EXPLANATION OF PLATES XLIV.-L.

Reference letters.—*a.*, Anus—*a.o.*, Swollen anterior end of œsophagus in head—*a.or.*, Anterior ovary—*a.ph.*, Anterior pharyngeal bulb—*b.*, Banded area on head—*b.m.*, Block-masses of granular tissue below ventral setæ—*c.s.*, Compound seta of outer row of ventral setæ—*cœl.*, Cœlome—*cut.*, Cuticle—*d.s.*, Dorsal locomotor setæ—*d.m.b.*, Dorsal, longitudinal, mesodermal band—*e.h.*, End-hairs—♀, *g.p.*, Female genital aperture—*gl.*, Glands lying above pharynx—*hd.*, Head—*h.h.*, Head-hairs—*int.*, Intestine—*i.r.*, Inner row of ventral setæ—*i.r'.*, Second inner row of ventral setæ—*l.o.*, Lateral sense-organ—*m.*, Mouth—*nk.*, Neck—*n.o.*, Swollen anterior end of œsophagus in neck—*o.r.*, Outer row of ventral setæ—*œ.*, (Esophagus—*ph.*, Pharynx—*p.ov.*, Posterior ovary—*p.r.*, Postanal portion of outer row of ventral setæ—*p.ph.*, Posterior pharyngeal bulb—*p.s.*, Penial setæ—*r.*, Rostrum—*rc.*, Rectum—*s.*, Simple setæ in front of inner rows of ventral setæ—*s.c.*, Subcuticular layer of body-wall—*s.s.*, Simple seta of outer row of ventral setæ—*sp.*, Sperms in uterus—*t.*, Testes—*t.h.*, Trunk-hairs—*t.h'.*, Short trunk-hairs between the long hairs—*tl.*, Tail—*t.g.*, Tail-gland—*ut.*, Uterus—*v.m.b.*, Ventral, longitudinal, mesodermal band—*v.s.*, Vesicula seminalis.

Plate xlv.—*Chaetosoma falcatum*, sp.n., ♂.

Fig. 1;—Side-view of a whole mount, (× 240), with the cuticle drawn in outline only, in order to show the position of the internal organs, the structure of which is only faintly discernible through the thick body-wall.

Fig. 1a.—Latero-ventral view of the posterior end of a male specimen, showing the arrangement of the four rows of ventral setæ, and the character of the striated cuticle; ($\times 520$).

Plate xlv.—*Ch. falcatum*, sp.n., ♀.

Fig. 2.—Side-view of a whole mount; ($\times 240$). The structure of the internal organs is not clearly visible through the thick cuticle.

Fig. 2a.—Posterior end of a female specimen, seen from the side; ($\times 520$).

Fig. 2b.—A compound seta; ($\times$ about 2000).

Plate xlv.—*Ch. haswelli*, sp.n., ♂.

Surface-view, from the side, of a whole male specimen; ($\times 240$). The very fine striations on the cuticle are only indicated in places.

Plate xlvii.—*Ch. haswelli*, sp.n., ♀; ($\times 240$).

Fig. 4a.—Sagittal, longitudinal section through anterior and middle region of body, showing alimentary and genital systems. The body-wall has been crushed out of its normal position during the process of embedding and section-cutting, so that the coelome is almost obliterated, and the section is narrower than the true width of the animal. The posterior end is cut out, and hairs and other delicate external structures do not show in a mount in Canada balsam.

Fig. 4b.—Whole mount of an immature specimen, with only a single row of dorsal setæ, and three pairs of ventral setæ.

Fig. 4c.—Anterior end of specimen shown in Fig. 4b.

Plate xlviii.—*Notochaetosoma tenax*, gen. et sp.n., ♂.

Side-view of a whole mount, ($\times 240$), showing the character of the thick, striated cuticle, and other external features. The sharp curvature at the anterior end is more pronounced in this specimen than is usually the case. Plate xlix. shows the more normal curvature.

Plate xlix.—*N. tenax*, n.sp., ♀; ($\times 240$).

Side-view of a whole mount, with the cuticle drawn only in outline, and the internal structure shown.

Plate l.—*N. cryptocephalum*, n.sp., ♂.

A whole mount, ($\times 240$). The posterior end was broken off during mounting, and is shown separated from the rest of the body. The strong, broadly ringed cuticle does not permit of a clear view of the internal structure.